

Book of Abstracts

The 63rd Annual Meeting of the Academy of Aphasia

October 26-28, 2025

Horton Hotel, San Diego, USA

Table of Contents (abstracts in alphabetical order, first author's last name)

Retrieval and conjugation of adjectives in Spanish-English speakers with aphasia Ioulia Agrotou, Philomena Elom, Mira Goral	17
Feature importance analysis for error prediction in aphasia using machine learning Afnan S. Al-Ali, Ahmed Bensaid, Samawiyah Ulde, Abeer Al-Marridi, Tariq Khwaileh	19
Inner speech and problem solving in aphasia Julianne M. Alexander, Brielle C. Stark	21
Predicting anomia trial-to-trail treatment accuracy and learning retention via performance factor analysis Marzieh Alidadi, William S. Evans, Peter Brusilovsky	25
Cognitive and cognitive-linguistic interventions in aphasia rehabilitation: A systematic review of treatment approaches and outcomes Anum Amin, Christie C. Duhigg, Sarah Walker, Rick Arenas, Jessica D. Richardson	28
Do psycholinguistic variables predict alexic reading performance beyond their effects in typical readers? Elizabeth J. Anderson, Andrew T. DeMarco, Peter E. Turkeltaub	31
Neural correlates of lexical activation and selection deficits in post-stroke aphasia Elizabeth J. Anderson, Preeti Rishi, Stephanie Riès	33
Towards AI-based evaluation of spoken picture naming Andrew Anderson, Sarah J. Pillay	36
Assessing cognition in bilingual aphasia: A scoping review Javad Anjum, Manaswita Dutta, Lidiya Khoroshenkikh, Brook E. Apple	38
Prosody function after stroke: evidence from a classification and an imitation tasks Giada Antonicelli, Karen Arellano, Nerea Gorostiola, Pia Hembach, Simona Mancini	47
Improving lexicosemantic impairments in people with post-stroke aphasia using repetitive transcranial magnetic stimulation targeting the right anterior temporal lobe Sophie Arheix-Parras, Sidney Crouse, Sophia Moore, Rutvik H. Desai	51
Left frontal and prefrontal regions support globally coherent discourse in aphasia Bobbi Aubrey, Brielle C. Stark	55
Personalized diagnosis and therapy for aphasic patients using Large Language Models Sreekar Baddepudi, Swathi Kiran	59

Connected speech features in post-stroke agrammatic aphasia: Evidence from Bengali Sayantani Banerjee, Arpita Bose, Niladri Sekar Dash, Abhijeet Patra	62
The contribution of bilingualism to cognitive reserve in Alzheimer's Disease: Evidence from neuropsychological functioning and biomarkers Wenfu Bao, Stephanie M. Grasso, Marco Calabria, Isabel Sala, M. Belén Sánchez-Saudinós, Lúcia Vaqué-Alcázar, Alexandre Bejanin, María Carmona-Iragui, Isale Barroeta, Ignacio Illán-Gala, Juan Fortea, Olivia Belbin, Daniel Alcolea, Alberto Lleó, Miguel Ángel Santos-Santos	65
Conversation-based therapy for aphasia: Neural reorganization and behavioral outcomes from a storytelling intervention Biraj Bhattarai, Bijoyaa Mohapatra	69
Test-retest reliability of TRF-derived measures of cortical tracking of speech in individuals with aphasia Kathleen E. Bradbury-John, G. Nike Gnanateja, Heather R. Dial	72
Exploring brain electric fields in Primary Progressive Aphasia therapy Christie Carroll-Duhigg, Julian David, Evon Youkhana, Anum Amin, Joel Upston, Maya Henry, Davin Quinn, Rick Arenas, Jessica D. Richardson	75
Perceived causality in aphasia rehabilitation: Perspectives of people with aphasia and communication partners Nichol Castro, Olivia A. Milonas, Sameer A. Ashaie	78
"Bridge over troubled water": An overview of music-based treatments as neurological bridges to rehabilitation for individuals with aphasia S. Alie Chandler	83
Language experience and prediction across age groups: evidence from diachronic fine-tuning of language models Alton Chao, Ellis Cain, Rachel Ryskin	85
Exploring strategies to foster therapeutic alliance in aphasia rehabilitation: Two case studies in mainland China Wenjun Chen, Anthony Pak-Hin Kong, Mengbi Gu, Min Tang	89
Classification of aphasia subtypes in Greek speakers using Artificial Intelligence Andreas Chitos, Suzan D. Scheffer, Tsegaye M. Tashu	93
Distributional semantic similarity enhances noun-verb priming for neurotypical, but reduces it for people with aphasia Sapna Chokshi, Michael Walsh Dickey, Tessa Warren, Haley C. Dresang	96

Relationship between verbal fluency and cognitive reserve in older adults	99
Nuria Cibeira, Isabel González-Abraldes, Julia Leira, Laura Lorenzo-López, Rocío López-López, Leire Lodeiro-Fernández, Silvia Martínez-Ferreiro	
Cerebellar tDCS in bilingual aphasia: A case series on language and executive function outcomes in PPA and post-stroke patients	102
Silke Coemans, Anastasia Lada, Esli Struys, Kyrana Tsapkini, Vânia de Aguiar, Sebastiaan Engelborghs, Jean-Christophe Bier, Philippe Paquier, Stephanie Keulen	
Language models derived surprisal and structural priming in aphasia: Implications for language recovery	105
Yan Cong, Jiyeon Lee	
Development of speech-based metrics for the assessment of speech and language abilities in Primary Progressive Aphasia	108
Sabia Costantini, Lisa Wauters, Carly Millanski, Heather R. Dial, Maya L. Henry	
Language follow-up and intervention in different stages of Alzheimer's Disease	112
Oona Cromheecke, Emma Depuydt, Marta Scarioni, Marijke Miatton, Arnaud Szmalec, Pieter van Mierlo, Miet De Letter, Evy Woumans	
The curious case of the cat rescue: Can picture narrative description inform visuospatial processing in aphasia?	115
Sarah G. Dalton, Javad Anjum, Davida Fromm, Brian MacWhinney	
Patterns of pathological language mixing during spontaneous speech in bilingual aphasia	119
Celine Davis, Clarissa Salas, Kathleen-Linnea Poindexter, David Ajayi, Jael Azemard, Gerald C. Imaezue	
Functionally communicative picture naming accuracy in aphasia: Rethinking ability	122
Dirk B. den Ouden, Laura Giglio, Sigfus Kristinsson, Sara Sayers, Julius Fridriksson	
Exploring the effects of a group aphasia treatment on the use of co-speech gestures	125
Suma R. Devanga, Mili Mathew	
Meta-analysis of VNeST effect sizes: Magnitudes and predictors of treatment benefits	128
Michael Walsh Dickey, Vanessa Nolan, Julia Shellard	
Breaking barriers: Challenges in communication partner training and ongoing AAC use in post-stroke aphasia	132
Chloe Domingues, Ally Peabody Smith	
Sound symbolism across multiple domains of meaning for people with aphasia	134
Josh Dorsi, Chaleece W. Sandberg, Simon Lacey, Lynne Nygaard, Krish Sathian	
Neural predictors of event knowledge access in individuals with aphasia	137
Haley C. Dresang, Abel Lei, Tessa Warren, Micheal Walsh Dickey	

Cognitive and expository discourse abilities in individuals with mild aphasia Manaswita Dutta, Hana Kim	140
Morphology vs. word order in agrammatic aphasia: A cross-linguistic study of Moroccan Arabic and English Loubna El Ouardi, Yasmeen Farooqi-Shah	144
Effects of dysarthria on Toisanese tone production: A case study Nancy Eng, Stanley Chen, Stella Yank	147
Assessing the cognate facilitation effect in anomia therapy: Evidence from two Spanish-Catalan bilinguals with aphasia Andrea Escoté, Margherita Montuori, Alejandro Villanueva, Inmaculada Rico Pons, Andrés Paipa, Claudia Peñaloza	149
Clustering and switching in verbal fluency tasks: Potential indicators of cognitive degradation in elderly Galician-Spanish bilinguals Ana María Estrada Pineda, José Carlos Jesús Millán Calenti, Micheal Rießler, Silvia Martínez Ferreiro	151
Response time modeling to predict optimal patient and item-specific confrontation naming deadlines Williams S. Evans, Jeffrey Starns	154
Quick Aphasia Battery in Primary Progressive Aphasia Zoe Ezzes, Lisa D. Wauters, Isabel E. Allen, Boon Lead Tee, Rian Bogley, Mia Lin, Siddarth Ramkrishnan, Diana A. Rodriguez, Maria Luisa Mandelli, Stephen M. Wilson, Maya Henry, Zachary A. Miller, Maria Luisa Gorno-Tempini	157
SEA-Battery: A new Spanish English Aphasia (SEA) battery for bilingual speakers Yasmeen Farooqi-Shah	161
A preliminary investigation on potential association between language tasks and cognitive status Yuan-Chi Feng, Chih-Chih Chan, Hsin-Ju Yang, Natalie Yu-Hsien Wang	163
Training word retrieval in aphasia through two semantic feature tasks: A case study Axel Fernández Zaionz, Leticia Vivas, Daniela Andreotti	165
Constructing multimodal bilingual input: Crosslinguistic interactions in text and image combinations Laura P. Fitzgerald, Jaime Antoshak, Jennifer Simpson, Giuseppina Hazen, Erica Axtell, Paula Ledesma, Tobias Kuhlmeier, Ainsley Perez, Leyla Galindo, Stephanie Riès, Henrike Blumenfeld	168
Exploring an acoustic metric for differential diagnosis of apraxia of speech Mikala Fleegle, Marianne Casilio, Stacey Steel, Courtney McCoy, Gerasimos Fergadiotis	173

Classification of lexical retrieval impairments in Primary Progressive Aphasia Naama Friedmann, Ophir Keret, Amir Glik, Yuval Z. Katz	177
‘Girdle’ for ‘guardrail’ and ‘batch’ for ‘match’: Formal paraphasia involving phonemically related real words is closely related to phonemic paraphasia Michitaka Funayama, Yoshitaka Nakagawa	180
Neural correlates of non-linguistic cognitive control in left hemisphere stroke survivors Andrea F. Gálvez-McDonough, Yusheng Wang, Peter E. Turkeltaub, Stephanie K. Riès	181
State-of-the-art analyses of fluency tasks in healthy and neurological populations Logan Gaudet, Jet M. J. Vonk, Jeffrey C. Zemla, Adrià Rofes	183
Socioeconomic factors in aphasia rehabilitation participation: A demographic analysis of a Houston-based program Nikita Gidh, Taegen Senawong, Eleni Christou-Franklin, Doris Kung	186
Narrative discourse rubric for non-fluent aphasia Isa Godoy, Tanya Dash, Esther Kim	189
Grammatical analysis of narrative in Broca’s aphasia, Wernicke’s aphasia, and age-matched non-aphasic speakers Jean K. Gordon	193
NfL, GFAP, and TDP-43 as predictive biomarkers of post-stroke cognitive impairment Nerea Gorostiola-Oyarzabal, Ana Joya, Maria del Mar Freijo, Raffaela Cipriani, Estibaliz Capetillo-Zarate, Abraham Martín, Simona Mancini	196
Translanguaging in aphasia: An innovative framework for multilingual language recovery Teresa Gray, Sarah Bellerda, Arissa Ventura, Chaleece Sandberg	199
Identifying neuropathological disease in Primary Progressive Aphasia through the analysis of spontaneous speech: A matter of artificial intelligence Daniel Gutstein, Micheal Iorga, Jane Stocks, Nathan Gill, Jennifer Sleeman, Tamar D. Gefen, Michelle Los, Eliyahu Lazovsky, Caroline Nelson, Changiz Geula, Sandra Weintraub, M-Marsel Mesulam, Todd Parrish, Elena Barbieri	202
Semantic relatedness and underlying sources of progressive anomia due to Alzheimer’s Disease versus FTLD-TDP-C Loreece G Haddad, Lauren Ables-Torres, Michelle Los, Sandra Weintraub, Tamar Gefen, Marek-Marsel Mesulam, Elena Barbieri	205
Social network composition influences chronic post-stroke aphasia recovery Lauren Hammond, Lisa Norris, William Matchin, Abigail Hogan, Julius Fridriksson, Dirk den Ouden	207

Exploring verb production difficulties in bilingual people with post-stroke aphasia Silvia De Marchi Hargrove, Mira Goral	210
Unlocking language therapy potential: A meta-analysis of CILT efficacy in aphasia recovery within the RTSS framework Denise Y. Harvey, Nicole R. Nissim, Suravi Sarkar, Kayla Alznauer, Rishi Vas, Zung Pham, Leslie H. Vnenchak, Roy H. Hamilton, Lynn M. Maher, H. Branch Coslett	213
Using flick input to address typing impairment in a Japanese-speaking person with aphasia: A case-based intervention Kosei Hashimoto, Koji Yamada, Shin Arai	215
Characterizing signatures of Alzheimer's disease and related disorders using functional near infrared spectroscopy Shalom K. Henderson, Shannon Kelley, Berk Tellioglu, Erie Shivers, Meryem Yucel, David Boas, Swathi Kiran	218
A crossover case study of two phonological treatments for anomia: Phonological components analysis and phonomotor treatment Molly Holcombe, Gabrielle Vasi, Peyton Tripp, Sofia Sozio, Hannah Meltzer, Nichol Castro	221
Beyond accuracy: Naming error patterns following therapy in Hebrew-speaking individuals with post-stroke aphasia Yuval Homsy, Tammar Truzman, Tali Bitan	224
Prosodic cues utilization for syntactic and pragmatic ambiguity resolution among Mandarin-speaking people with aphasia Yi Hu, Haiyan Wang	226
Replicable error coding: A large-scale automated coder for coding errors in word production tasks Shanhua Hu, Delaney DuVal, Brielle C. Stark, Nazbanou Nozari	228
Democratizing lesion symptom mapping in aphasia research with manual lesion segmentation training Isabella Huynh, Erin Yi, Jeremy Yeaton, Danielle Fahey	230
Recursive self-feedback enables target language production in bilingual aphasia with pathological language mixing Gerald C. Imaezue, Celine Davis, Krishna Veni Maram, David Ajayi, Mira Goral	233
Effects of age and noun-verb co-occurrence strength on action picture naming accuracy: A cross-sectional study of typically developing native Japanese children and healthy adults Yuki Ishii, Akira Uno, Jun Tanemura	237

Balanced tasks, unbalanced performance: Noun and verb processing in post-stroke aphasia Maria V. Ivanova, Olga Soloukhina, Olga Buivolova, Olga Dragoy	240
Brain and language: An analysis of language processing in aphasia among adults in select tier four hospitals, Nakuru County, Kenya Mercy Rose Jesang	243
The impact of communication events on communicative stress in people with aphasia: An ecological momentary assessment study Courtney C. Jewell, Jessica Krok-Schoen, Stacy M. Harnish	245
In which cases are prepositions difficult to judge? Disentangling impairments in word order and functional elements in agrammatic aphasia Yuval Z. Katz, Naama Friedmann	248
Development and validation of the animated sentence production test for aphasia Zeinab Khoshhal Mollasaraei, Gregory Hickok, Dirk B. den Ouden, Julius Fridriksson, William Matchin	251
The development of stimuli for bilingual abstract semantic associative network training (BAbSANT) for Persian Persons with Aphasia Faranak Kianfar, Chaleece W. Sandberg	255
Applications of noninvasive brain stimulation to the treatment of post-stroke and progressive aphasia Aneta Kielar, Olga Boukrina, Priyanka Shah-Basak	258
Investigating speech pauses and rhythm in aphasia: A usage-based approach Jieun Kim, Mara Breen, Rosemary Varley	261
A time-efficient naming assessment for Korean speakers with aphasia using the Rapid Naming Test So Eun Kim, Junyoung Shin, Sujin Choi, Boon Lead Tee, Jee Eu Sung	264
Network-level involvement in slower language processing speed in glioma patients: A multimodal neuroimaging study Ryuta Kinno, Manabu Tamura, Takashi Maruyama, Yoshihiro Muragaki, Ayako Osanai, Satomi Kubota, Akinori Futamura, Kuniyoshi I. Sakai	267
Naturalistic versus modular and controlled assessment of language processing in aphasia Swathi Kiran, William Graves, Elena Barbieri, Einat Liebenenthal, Sam Nastase	269

A comparison of face-to-face versus tele-mode of Intensive and Comprehensive Aphasia Program (ICAP) for Cantonese speakers in Hong Kong	272
Anthony Pak-Hin Kong, Cherie Wan-Yin Wong, Ada Wai-Sze Chu	
Right cerebellar functional connectivity predicts linguistic abilities in post-stroke aphasia	274
Emerson Kropp, Nicole Carvalho, Rajani Sebastian, Swathi Kiran, Maria Varkanitsa	
Language network reorganization after stroke: Effects of aphasia type and severity	278
Svetlana V. Kuptsova, Ava M. Singh, Arianna LaCroix	
Mapping of critical prosodic and phonetic networks in post-stroke apraxia of speech	280
G. Lynn Kurteff, Grant M. Walker, Julius Fridriksson, Gregory Hickok	
Idiom comprehension in Alzheimer's Disease – A systematic review	284
Anastasia Lada, Silke Coemans, Philippe Paquier, Christina Manouilidou, Ifigeneia Dosi, Stephanie Keulen	
Retrieval facilitates retention: Long-term effects of implicit structural priming treatment in aphasia	286
Jiyeon Lee, Catherine T. Pham, Peng Zhang, Victor Ferreira, Nadine Martin, Katelin M. Rainey, Emily Bauman, Sein Min	
Linguistic tools for the early diagnosis of dementia: A systematic review	288
Julia Leira, Isabel González-Abraldes, Nuria Cibeira, Ana Maseda, Silvia Martínez Ferreiro	
Linguistic diversity in neurodevelopment: Investigating the role of bilingualism on post-stroke cognitive and linguistic outcomes	290
Kai Ian Leung, Robyn Westmacott, Nomazulu Dlamini, Elizabeth Rochon, Monika Molnar	
The relationship between non-language cognitive function and brain networks changes in post-stroke aphasia patients	292
Siqi Li, Yumei Zhang	
Using semantic networking strategies, habit formation, and prompt fading to improve anomia for aphasic individuals	295
Mei-Hua Li, Lauryn Zipse, Esther Herring, Anthony Pak-Hin Kong, Sofia Vallila-Rohrer	
Neuropathological fingerprints of language in Primary Progressive Aphasia – revisited	299
Michelle Anne Los, Jane Kathleen Stocks, Tamar Gefen, Changiz Geula, Elena Barbieri, Marek-Marsel Mesulam, Sandra Weintraub	
A mindfulness-based intervention for improving mental health and loneliness in people with aphasia	302
Sandy J. Lwi, Janell Flores Bolte, Janet Patterson, Juliana V. Baldo	

Eliciting naturalistic, experimentally controlled sentence recordings from people with aphasia: A pilot study Jennifer E. Mack, Angela Murzin, Madeline Peck	304
Recent developments in AphasiaBank Brian MacWhinney, Davida Fromm	307
Interbrain synchrony as a potential biomarker of communicative success in aphasia: Preliminary evidence from fNIRS hyperscanning Grace Magee, James Colwell, Joseph Licata, Shannon Kelley, Berk Tellioglu, David Boas, Swathi Kiran, Maria Varkanitsa, Erin Meier, Meryem Yücel	309
Speech entrainment practice in aphasia: Efficacy and optimal training parameters Marja-Liisa Mailend, Shauna Zodrow, Laurel Buxbaum, Erica Middleton	311
First steps towards simulating aphasia in a neural network of human speech processing Ihintza Malharin, M. Belén Saavedra, Linkai Peng, Simona Mancini, James S. Magnuson	314
International practices of speech-language pathologists working with bilingual speakers with Primary Progressive Aphasia Sonia-Karin Marqués Kiderle, Lucas Ansín Gómez, Núria Montagut, Jade Cartwright, Regina Jokel, Monica Lavoie, Ellen McGowan, Margaret Pozzebon, Bárbara Costa Beber, Guillaume Duboisindien, Monica Norvik, Taiki Sugimoto, Rosemary Townsend, Nina Unger, Ingvild E. Winsnes, Anna Volkmer, Jeanne Gallée, Stephanie Grasso	317
Multimodal analysis of linguistic, emotional and visual attention processing of naturalistic movie stimuli in persons with aphasia Manuel Jose Marte, Bryce Gillis, Kari Goldin, Xuehu Wei, Colin Galvin, Laura Rigolo, Yanmei Tie, Swathi Kiran, Einat Liebenthal	321
The N400 and semantic priming in a naturalistic cross-modal priming paradigm Ian Martindale, Seana Coulson	324
Assessment of social cognition in individuals with Traumatic Brain Injury and neurotypical adults Niya Mathew, Pooja Chandrashekar, Hema Nagaraj	327
Corticobasal syndrome associated with prominent phonological dyslexia: A case report Kana Matsuda, Naoko Nakamura, Ryotaro Sanda, Yoshinori Hirata, Hidehiro Ishikawa, Yukito Ueda, Yutaka Tanaka, Akihiro Shindo	329
Barcelona scale for buccophonatory apraxia in Primary Progressive Aphasia: A longitudinal case series Núria Montagut, Sergi Borrego-Écija, Jorge Herrero, Cristina Vela, Mircea Balasa, Albert Lladó, Stephanie Grasso, Raquel Sánchez-Valle	331
Simulating semantic paraphasia with Japanese Large Language Models Saori Morita, Yuto Harada, Taiga Naoe, Tsukasa Okimura, Yohei Oseki	333

Cerebello-cerebral functional connectivity in Primary Progressive Aphasia	336
Jamie L. Murter, Rajani Sebastian, Andreia V. Faria, Rhonda B. Friedman, Aaron M. Meyer, Sarah F. Snider, Argye E. Hillis, Donna C. Tippet	
Discourse profiles in children with and without aphasia: A comparative study of syntactic complexity and communicative content	339
Hema Nagaraj, Pooja Chandrashekar	
The role of the right and left hemispheres in verbal fluency: Evidence from bvFTD and nfvPPA	341
Kyriaki Neophytou, John Papatriantafyllou, Kyrana Tsapkini	
Bilingual aphasia outcomes of a quasi-experimental study of an Adapted ECoLoGiC-Treatment	344
Yael Neumann, Marion C. Leaman, Aviva Lerman	
Mediating influence of psycholinguistic predictors on spelling and reading performance in Primary Progressive Aphasia	350
Katlyn Nickels, Aneta Kielar	
How “healthy” is the unaffected hemisphere? Linking structural changes to language in people with gliomas	354
Effy Ntemou, Thomas Picht, Katharina Faust	
Promoting autonomy through communication access: A study of Patient Reported Outcome Measure (PROM) administration in aphasia	357
Catherine A. Off, Jenna R. Griffin-Musick, Victoria L. Scharp, Danielle Fahey	
“It’s my life to take care of her”: Perspectives on caregiving for people with aphasia	360
Olivia E. Olley, Amanda G. Prinzi, Chitrali R. Mamlekar	
Brain MRI findings among patients presenting with neurological symptoms at a Nigerian tertiary healthcare facility	365
Kenneth C. Oparaji, Darlington-Peter C. Ugoji, Victor U. Chukwu, Miracle N. Okoche, Chibuike G. Okereke	
Effect of forced prediction on syntactic priming in neurologically intact middle-aged and older adults	366
Parisa Osfoori, Chaleece W. Sandberg, Carrie Neal Jackson	
Unmasking delayed decay and integration impairments in aphasia: ERP evidence from masked priming	369
Ashlie H. Pankonin, JoAnn P. Silkes	

Cross-linguistic and cross-cultural effects on picture description in Korean and English individuals with and without aphasia Jimin Park, Yae Rin Yoo, Jee Eun Sung	373
Acting vs. Cinderella retelling: Individual differences in syntax errors between primed and discourse tasks Mia Parkes, Ashlynn Everett, Catherine Payne, Jeremy Yeaton, Catherin Off, Jenna Griffin, Simona Mancini, Danielle Fahey	377
Syntactic organization in aphasia: Insights from individual-level network analyses of connected speech Catherine T. Pham, Peng Zhang, Nichol Castro, Jiyeon Lee	380
Singing supports motor speech and syntax production: Evidence from aphasia Alexis L. Pracar, Maria V. Ivanova, Nicoletta Biondo, Nina F. Dronkers	384
Altered temporal dynamics during syntactic integration in nonfluent variant Primary Progressive Aphasia M. Blake Rafferty, Heather R. Dial, Rachel S. Tessmer, Maya L. Henry	386
Caregiver and patient with aphasia communication dynamics: A pilot study on barriers and strategies Ayana Das Ramdasan, Akshay P. Vibin, Krishnedu K. R.	390
Cortical hierarchy and aphasia severity: The sensorimotor-association gradient modulates lesion effects within language-specific networks Ida Rangus, Nicholas Riccardi, Julius Fridriksson, Leonardo Bonilha	391
Word-form learning and re-learning in the aging brain Brenda Rapp, Yuan Tao, Sartaj Singh, Jennifer Shea, Robert Wiley	396
Bilingual aphasia and aging Stephanie K. Ries, Stephanie M. Grasso, Miguel Ángel Santos Santos, Eve Higby, Tamar H. Gollan, Matthew Goldrick, and Mira Goral	398
The lived experiences of Chinese-speaking individuals with aphasia: Implications for clinical practice Preeti Rishi, Yusheng Wang, Emily Zhang, Xi Zhao, Audrianna Leung, Tracy Love, Henrike K. Blumenfeld	401
Control group design shapes treatment effects in aphasia randomized controlled trials: Insights from a systematic review and meta-analysis Marissa Russell-Meill, Alexandra Piper-Wagner, Marian Brady, Caterina Breitenstein, Katerina Hilari, Swathi Kiran	405
Written multiplication and subtraction in aphasia: A voxel-based lesion-symptom mapping Elena Salillas, Maria Varkanitsa, David Fernández, Swathi Kiran, Carlo Semenza	409

Addressing ecological validity in aphasia through dual-and multi-tasking research: Recent advances	413
Christos Salis, Laura L. Murray, Tyson G. Harmon, Jacqueline Hinckley, Janet Patterson, Stephanie Karidas	
From sentence to discourse to conversation: A novel therapy for people with mild aphasia	415
Julie Schlesinger, Leslie Vnenchak, Joseph Sheridan, Harris Drachman, Nadine Martin, H. Branch Coslett	
Real-time processing of semantic constraint during silent reading: Evidence from eye-tracking	417
Micheal Scimeca, Maria Varkanitsa, Swathi Kiran	
Investigating the contribution of phonological short-term memory to sentence comprehension in post-stroke aphasia	421
Priyanka Shah-Basak, Sara B. Pillay, Andrew Anderson, Jeffrey R. Binder	
Refining a culturally adapted naming test: item reduction and psycholinguistic profiling of the Korean BNT for aphasia severity prediction	424
Junyoung Shin, Sejin Oh, Sujin Choi, Yu Mi Hwang, Sung-Bom Pyun, Jee Eun Sung	
Comparison of picture-naming errors produced by individuals with post-stroke aphasia (PSA) and individuals with variants of Primary Progressive Aphasia (PPA)	428
Erie H. Shivers, Marissa Russell-Meill, Shalom Henderson, Lucía Fernández-Romero, Divya Sivakumar, Maria Valiente, Jordi A. Matias-Guiu, Swathi Kiran	
To cue or not to cue? Preliminary findings from three anomia treatments	431
Tijana Simic, Rudra Patel, Madeleine Coppolino, Aaron Vincent, Chaerin Jang, Erin Kim, Nadia Faehndrich	
Shared neural bases for word-form learning and re-learning	434
Sartaj Singh, Robert Wiley, Yuan Tao, Jennifer Shea, Brenda Rapp	
Reducing the need for cueing: The impact of tDCS on sentence comprehension in aphasia	436
Luke Sippel, Ellyn A. Riley	
Intermittent Theta Burst Stimulation and its influence on video action naming in individuals with post-stroke aphasia	438
Manon Spigarelli, Hugo Massé-Alarie, Maximiliano Wilson	
Combining personalized anomia intervention with computer-based spaced-retrieval training for PPA: Initial outcomes	440
Mara Steinberg Lowe, Amy Vogel-Eyny	
Theory of mind predicts effective conversation in early right hemisphere stroke	443
Andrea Suazo, Margaret Blake, Tatiana Schnur	

Syntactic complexity as a behavioral marker of amyloid-β positivity in Mild Cognitive Impairment	447
Jee Eun Sung, Sujin Choi, Solmyeong Seo, Miryu Yoon, Jee Hyang Jeong	
Towards the neurocognitive mechanisms underlying Semantic Feature Analysis	451
Alexander M. Swiderski, Michael Walsh Dickey, William D. Hula	
Factors determining the successful use of AI-based AAC tool in a patient with aphasia - a case report	454
Nobuhiro Takatsu, Michiyuki Kawakami, Nami Tamura, Emiri Kase, Mari Ito, Kunitsugu Kondo	
Mapping and decoding semantic representations in aphasia after stroke	456
Jerry Tang, Carly Millanski, Lisa D. Wauters, Shilpa Shamapant, Stephen M. Wilson, Alexander G. Huth, Maya L. Henry	
Co-occurring impairments in object decision and Kanji lexical decision following left temporo-occipital stroke: A single-case study	458
Ayane Tateba, Kosei Hashimoto, Takahiro Okazaki, Koichi Ikeno, Mutsuo Ijuin	
“Overwhelmed by curious”: Care partner perspectives on education, resources and coping after aphasia diagnosis based on preliminary data	460
Grace E. Terry, Jennifer Brello, Stacy M. Harnish	
Mapping patient linguistic profiles to neurological conditions using AI	462
Charalambos Themistocleous, Brielle Stark	
Naming treatment in aphasia: How individual differences and error types predict response to retrieval practice and errorless learning	464
Yingxue Tian, Marja-Liisa Mailend, Daniel Mirman, Erica Middleton	
Historical review of autobiographical accounts of aphasia	466
Bethan Tichborne, Arpita Bose	
Automated lesion segmentation using acute and chronic stroke MRI with nnU-Net	468
Tammar Truzman, Matt Lambon Ralph, Ajay Halai	
Three Japanese-speaking individuals with phonological dyslexia without phonological impairment	471
Shinji Uema, Kosei Hashimoto, Akira Uno	
Building a corpus of Arabic aphasia	474
Samawiyah Ulde, Abeer AlMarri, Afnan Alali, Ahmed Bensaid, Tariq Khwaileh	
Predictive processing and memory in aphasia: Evidence from webcam-based eye-tracking	476
Willem S. van Boxtel, Ally Miller, Callie Cody, Allie Folse	

Unraveling sentence complexity in Primary Progressive Aphasia: How number dissimilarity and phonological cues modulate the comprehension of subject ad object relatives in French	478
Mauro Viganò, Marc Teichmann, Carlo Cecchetto	
Language impairment profile of a polyglot following neurosurgical resection: A case report	481
Catherine Wang, Ilina Bhaya-Grossman, Jill Kries, Edward Chang	
Cerebral reorganization in post-stroke anomia: An fNIRS pilot study	484
Meng Huan Wang, Wei Wei Dou, Jing Gao, Dan Dan Liang	
Regional atrophy patterns in post-stroke aphasia: A voxel-based morphometry study	487
Qingchun Wang, Fang Wang, Yang Liu, Lu Yu, Tian Jiang, Yongkun Guo, Jiajun Zhang, Yuan Lyu, Xinjun Wang, Wai-Ting Siok	
Speech-language treatment for non-progressive aphasia in people who speak tone languages	489
Guanyu Wei	
Virtual reality-based script training for rehabilitation of functional communication of Cantonese speakers with aphasia: Findings from a pilot randomized controlled trial	495
Winsy W.S. Wong, Donald S. P. Li, Mohammad Momenian, Hoi Tsz Kwok, Cynthia M. H. Ng, Eric H. C. Shih, Leanne W. Y. Chung, Virginia S. W. Ku, Karen H. L. Wong	
Cognitive mediation of autonomic effects on language function in post-stroke aphasia	497
Qiu Yang Xu, Meng Huan Wang, Ya Ting Sun, Lily Zihe Yin, Dan Dan Liang	
Neural correlates of apraxia of speech and their functions in speech production: Evidence from Primary Progressive Aphasia (PPA)	500
S.C. Angela Xu, Donna C. Tippet, Robert Wiley, Brenda Rapp, Kirana Tsapkini	
Overarching paragrammatism: Shared circuitry for paragrammatism and syntactic comprehension deficits in post-stroke aphasia	502
Jeremy D. Yeaton, Danielle Fahey, William Matchin, Dirk den Ouden, Julius Fridriksson, Gregory Hickok	
Mapping aphasia profiles to AI and human treatment decisions: Toward clinician-informed systems	505
Hyunsoo Yoo	
Automated scoring of story retelling performance in people with aphasia using Large Language Models	508
Yae Rin Yoo, Yoonseob Lim, Jee Eun Sung	

RESPALDO: a psychosocial education program for Latino/Hispanic care partners of people with progressive aphasia	512
Giselle A. Yoshimoto, Katie C. Cole, Diana F. Cruz, Camille Wagner-Rodriguez, Karla Patricia Gutierrez Sanchez, Mariana Longoria Ibarrola, Maria F. Quiñones Vieta, Maya L. Henry, and Stephanie M. Grasso	
Who benefits from structural priming? The role of cognition and language severity in aphasia	516
Peng Zhang, Willem van Boxtel, Victor Ferreira, Nadine Martin, Jiyeon Lee	
Mapping cerebellar volume patterns in Primary Progressive Aphasia and its underlying neuropathologies	519
Viktoria Zilkova, Nayana Ramesh, Adithya Sathyamurthy, Jordan Q. Behn, Tamar D. Gefen, Changiz Geula, Marek-Marsel Mesulam, Elena Barbieri	
Evaluating speech entrainment as a treatment for non-verbal individuals with aphasia: A case study	522
Shauna Zodrow, Marja-Liisa Mailend	

Retrieval and Conjugation of Adjectives in Spanish-English Speakers with Aphasia

Ioulia Agrotou^{1*}, Philomena Elom¹, Mira Goral^{1,2}

¹Program in Speech-Language-Hearing Sciences, The Graduate Center, The City University of New York, New York, NY, USA

²Department of Speech-Language-Hearing Sciences, Lehman College, The City University of New York, New York, NY, USA

***corresponding author, iagrotou@gradcenter.cuny.edu**

Introduction

Lexical retrieval deficit is a typical impairment of aphasia. Most research involving people with aphasia has focused on the production of nouns and verbs. Adjectives, despite their importance in communication, remain underexplored in the aphasia literature, particularly in studies of aphasia in bilingual people. In morphologically rich languages like Spanish, adjectives must agree in gender and number with the nouns they modify (Meltzer-Asscher & Thompson, 2014). For people with aphasia, previous studies have demonstrated that grammatical agreement, especially in gender pose particular difficulties (Piazza et al., 2022). Few studies have examined these patterns in post-stroke bilingual speakers, across both languages. The current study specifically investigates adjective retrieval and agreement in Spanish-English bilinguals with aphasia. The aim is to discover the extent of impairment as well as any dissociations between the different adjective production processes.

Methods

The following research questions will be addressed: (1) Is the accuracy of adjective retrieval different than the accuracy of noun and verb retrieval in L1 and L2? (2) In Spanish, how does adjective retrieval compare with adjective agreement (conjugation)? (3) In Spanish, are gender agreement errors more common than number agreement errors? (4) To what extent do individual factors such as aphasia severity, education, and years post-stroke affect adjective performance?

Nine Spanish-English bilinguals with aphasia (ages 18–74) completed an Adjective Noun Agreement Task (ANAT) in the three-parts: ANAT1 targeting adjective retrieval, ANAT2 targeting color adjectives and ANAT3 targeting plural adjective-noun agreement. Each participant was tested in both Spanish and English across a total of 108 items. Responses of both were coded for accuracy in both languages and only in Spanish for gender and number agreement.

Results

Results showed that adjective retrieval accuracy was comparable to noun naming accuracy and slightly higher than verb naming accuracy in both languages. Seven out of eight participants exhibited low error rates. The scores revealed relatively more number errors than gender errors, suggesting that number agreement was slightly more challenging (~13% error rate) than gender agreement (~9%).

Aphasia severity measured by the WAB-AQ was a strong negative predictor of performance, with more severe aphasia associated with lower accuracy and more agreement errors. Educational background correlated positively with performance, while a greater number of years post-stroke predicted increased error rates in gender and number agreement.

Conclusions

This study contributes insights into how adjective retrieval and agreement function in bilingual aphasia, revealing an interplay between grammatical category, agreement, and individual background. The findings reveal the importance of including tasks with adjectives in the aphasia assessment, particularly for bilingual individuals of two structurally different languages.

References

- Meltzer-Asscher, A., & Thompson, C. K. (2014). The forgotten grammatical category: Adjective use in agrammatic aphasia. *Journal of Neurolinguistics*, 30, 48–68.
- Piazza, G., Calabria, M., Semenza, C., & Poletto, C. (2021). Processing of semantic and grammatical gender in Spanish speakers with aphasia. *Aphasiology*, 36(8), 940–961.

Feature Importance Analysis for Error Prediction in Aphasia Using Machine Learning

Afnan S. Al-Ali¹, Ahmed Bensaid², Samawiyah Ulde^{1*}, Abeer Al-Marridi¹, Tariq Khwaleh¹

¹ Department of English Literature and Linguistics, Qatar University, City, Doha, Qatar

² Department of Student Data Analytics, Qatar University, City, Doha, Qatar

***corresponding author, samawiyah.ulde@qu.edu.qa**

Introduction

Advances in machine learning (ML) have improved the classification of paraphrastic errors in aphasia. Early efforts, such as by Ahuja et al. (1986), simulated phonemic errors using heuristic search, offering one of the first computational models for phonological breakdowns. Ash et al. (2010) later provided neuropsychological evidence linking errors in progressive non-fluent aphasia to phonemic disruptions. Fergadiotis et al. (2016) developed methods to classify five paraphasia types—formal, semantic, mixed, unrelated, and nonword—with high agreement to expert raters. These efforts enhanced accuracy in error detection but lacked transparency: most ML models functioned as “black boxes,” failing to clarify which psycholinguistic and lexical features influence each error type and in what order. This limits both interpretability and clinical utility. The present study addresses this gap by applying explainable ML to identify the most influential features predicting each paraphasia class in four aphasia subtypes: Anomic, Broca’s, Wernicke’s and Conduction aphasia.

Methods

We used the Moss Aphasia Psycholinguistics Project Database (Mirman et al., 2011), which includes naming errors labeled by response type. The study focused on four aphasia types, constructing five binary classifiers, each trained to distinguish one error type from all others. Seven psycholinguistic and lexical features (frequency, imageability, syllable count, visual complexity, length, age of acquisition, and phonological density) were extracted per target word. We employed an XGBoost classifier, using subsampling to handle class imbalance. Feature importance was derived from each model’s internal interpretability methods to assess the relative contribution of each feature in predicting the five error types.

Results

Across all aphasia types, the occurrence of formal errors is most strongly predicted by lexical frequency, visual complexity, syllable count, and phonological neighborhood density. Mixed errors are primarily associated with visual complexity, with additional, though weaker, contributions from imageability, phonological density, and frequency. Interestingly, semantic errors are best predicted not only by imageability—as theoretical models would suggest—but also by frequency and phonological density, which is unexpected. Unrelated errors are predicted by syllable count, word length, visual

complexity, and, in cases of anomia, age of acquisition. Nonword errors are influenced by word length and frequency.

Conclusions

Notably, the aphasia type does not modulate these effects; for example, the influence of imageability on semantic errors appears to be independent of whether the individual presents with fluent or non-fluent aphasia. Many of these findings are consistent with established theoretical expectations and models of language production. However, some are distinctly contradictory. For example, the finding that semantic errors in anomia are predominantly predicted by phonological density overall other variables is not readily explainable by many by many popular existing theories. Moreover, the dominant influence of visual complexity, relative to features like imageability and age of acquisition, was unanticipated. This may be due to the underlying distribution of the data, as visual complexity ratings exhibit greater variability. These observations highlight the need to critically evaluate the methodological basis of these psycholinguistic feature ratings and suggest that further scrutiny of their internal consistency and derivation is necessary.

References

- Ahuja, S. B., Reggia, J. A., & Berndt, R. S. (1985). Automated classification of phonological errors in aphasic language. *Computer Methods and Programs in Biomedicine*, 21(2), 133–141.
- Ash, S., McMillan, C., Gunawardena, D., Avants, B., Morgan, B., Khan, A., Moore, P., Gee, J., & Grossman, M. (2010). Speech errors in progressive non-fluent aphasia. *Brain and Language*, 113(1), 13–20.
- Fergadiotis, G., Gorman, K., & Bedrick, S. (2016). Algorithmic Classification of Five Characteristic Types of Paraphasias. *American Journal of Speech-Language Pathology*, 25(4S), S776–S787.
- Hassija, V., Chamola, V., Mahapatra, A., Singal, A., Goel, D., Huang, K., Scardapane, S., Spinelli, I., Mahmud, M., & Hussain, A. (2024). Interpreting Black-Box Models: A Review on Explainable Artificial Intelligence. *Cognitive Computation*, 16(1), 45–74.
- Mirman, D., Strauss, T. J., Brecher, A., Walker, G. M., Sobel, P., Dell, G. S., & Schwartz, M. F. (2010). A large, searchable, web-based database of aphasic performance on picture naming and other tests of cognitive function. *Cognitive Neuropsychology*, 27(6), 495–504.

Acknowledgments

This research is funded by the Qatar Research, Development and Innovation (QRDI) Council via the grant ARG01-0503-230065 awarded to Tariq Khwaileh.

Inner Speech and Problem Solving in Aphasia

Julianne M. Alexander^{1,2*} and Brielle C. Stark^{1,2}

¹Department of Speech, Language and Hearing Sciences, Indiana University,
Bloomington, Indiana, USA

²Program in Neuroscience, Indiana University, Bloomington, Indiana, USA

*corresponding author, julifrye@iu.edu

Introduction

The mechanisms behind connections in problem solving and language abilities are unknown (Baldo et al., 2015), and as the “little voice in the head,” inner speech is situated to be one such mechanism. People with aphasia experience varying degrees of preserved inner speech despite the severity of the language disorder (Alexander et al., 2023; Geva et al., 2011; Stark et al., 2017). By studying this connection in people with aphasia, there is a unique opportunity to explore the role of inner speech in cognitive processes such as problem solving and executive function (Fama et al., 2024). This project has two aims: 1) examine the relationship between inner speech and problem-solving abilities in adults with and without aphasia and 2) investigate the effects of interfering with inner speech during problem solving.

Methods

People with aphasia and age-similar healthy adults completed assessments of cognition, inner speech, and psychosocial health. People with aphasia completed assessments of language and awareness of their language deficits as well as inner speech and problem-solving tasks. To assess the connection between inner speech and problem solving, all participants completed a non-verbal problem-solving task (Wisconsin Card Sorting Test) during a dual task paradigm with three conditions: no interference (baseline), verbal interference (articulatory suppression) and non-verbal interference (finger tapping). Articulatory suppression is known to disrupt inner speech (Baldo et al., 2005; Nedergaard et al., 2023; Wallace et al., 2017), allowing for investigation into how inner speech may facilitate problem solving. Linear modeling was used to predict performance based on demographic, neuropsychological, and interference factors.

Results

Performance on problem-solving tasks positively related to performance on an objective task of inner speech. As seen in Table 1, adults without aphasia outperformed people with aphasia on the problem-solving task. Based on linear modeling, there were interactions based on inner speech ratings and interference conditions (Figure 1). There was a large learning effect from the baseline condition to the interference conditions, but the verbal interference condition showed less improvement than the non-verbal interference condition. Aphasia severity, but not anosognosia, also predicted performance for people with aphasia.

Conclusions

This project is a comprehensive investigation into the role of inner speech in problem-solving tasks in adults with and without aphasia. Using a combination of established tasks (e.g., Wisconsin Card Sorting Test, covert rhyme judgment, successful inner speech during naming) and innovative methods (e.g., articulatory suppression, self-reported outcome measures), the project contributes valuable insights into the fields of speech-language pathology, aphasiology, and cognitive neuroscience. The results inform clinical decision-making and help to better understand the importance of inner speech in aphasia recovery and cognition.

References

- Alexander, J. M., Langland-Hassan, P., & Stark, B. C. (2023). Measuring Inner Speech Objectively and Subjectively in Aphasia. *Aphasiology*, 38(5), 1–26.
- Baldo, J. V., Dronkers, N. F., Wilkins, D., Ludy, C., Raskin, P., & Kim, J. (2005). Is problem solving dependent on language? *Brain and Language*, 92(3), 240–250.
- Baldo, J. V., Paulraj, S. R., Curran, B. C., & Dronkers, N. F. (2015). Impaired reasoning and problem-solving in individuals with language impairment due to aphasia or language delay. *Frontiers in Psychology*, 6.
- Fama, M. E., McCall, J. D., DeMarco, A. T., & Turkeltaub, P. E. (2024). Evidence from aphasia suggests a bidirectional relationship between inner speech and executive function. *Neuropsychologia*, 204, 108997.
- Geva, S., Bennett, S., Warburton, E. A., & Patterson, K. (2011). Discrepancy between inner and overt speech: Implications for post-stroke aphasia and normal language processing. *Aphasiology*, 25(3), 323–343.
- Nedergaard, J. S. K., Wallentin, M., & Lupyan, G. (2023). Verbal interference paradigms: A systematic review investigating the role of language in cognition. *Psychonomic Bulletin & Review*, 30(2), 464–488.
- Stark, B. C., Geva, S., & Warburton, E. A. (2017). Inner Speech's Relationship With Overt Speech in Poststroke Aphasia. *Journal of Speech, Language, and Hearing Research*, 60(9), 2406–2415.
- Wallace, G. L., Peng, C. S., & Williams, D. (2017). Interfering With Inner Speech Selectively Disrupts Problem Solving and Is Linked With Real-World Executive Functioning. *Journal of Speech, Language, and Hearing Research*, 60(12), 3456–3460.

Acknowledgments

This research was supported by a William Orr Dingwall Dissertation Fellowship in the Foundation of Language and an ASH Foundation New Century Scholars Doctoral Scholarship, both awarded to Julianne M. Alexander.

We would like to thank research assistants Tessa Hedrick, Zoe Evans, Prit Kaur, and Leena Hussein for your hard work and dedication to data collection and entry. Additional thank you to Emily Norton from the Indiana University Statistical Consulting Center for your expertise and guidance throughout the data analysis.

Figure 1: Inner Speech Rating and Wisconsin Card Sorting Test accuracy, separated by interference condition. Participants were asked how often they used inner speech during the task, from 0-100%.

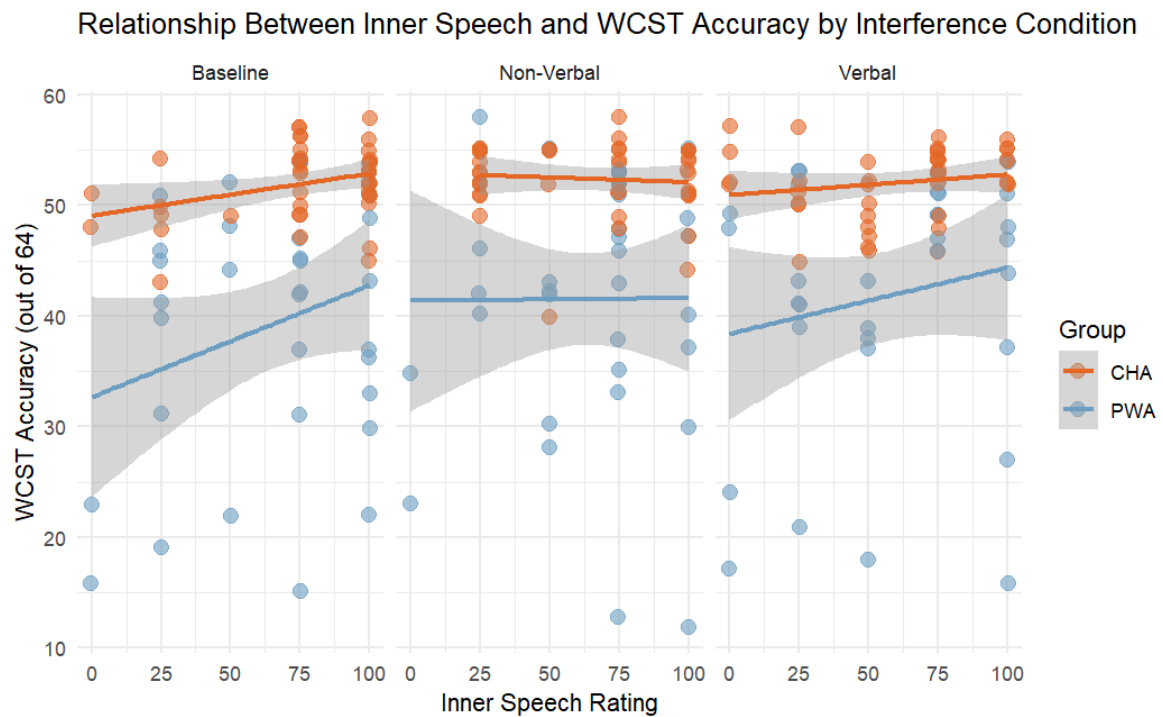


Table 1: Descriptive Statistics and Group Comparisons on Main Outcome Measures. CHA = cognitively healthy adults, PWA = people with aphasia, WCST = Wisconsin Card Sorting Test.

	CHA (N=42)	PWA (N=33)	Statistics
WCST Baseline Accuracy (out of 64)			
Mean (SD)	51.9 (3.37)	39.3 (11.6)	$t(36) = 6.05$
Median [Min, Max]	52.5 [43.0, 58.0]	42.0 [15.0, 54.0]	$p < .001$
WCST Verbal Interference Accuracy			
Mean (SD)	52.0 (3.16)	41.8 (11.4)	$t(36) = 5.01$
Median [Min, Max]	52.0 [45.0, 57.0]	46.0 [16.0, 54.0]	$p < .001$
WCST Non-Verbal Interference Accuracy			
Mean (SD)	52.4 (3.30)	41.5 (11.4)	$t(36) = 5.27$
Median [Min, Max]	53.0 [40.0, 58.0]	43.0 [12.0, 58.0]	$p < .001$
Successful Inner Speech during Naming – Percent Correct			
Mean (SD)	100 (0)	96.7 (10.5)	$t(32) = 1.82$
Median [Min, Max]	100 [100, 100]	100 [40.0, 100]	$p = .08$
Inner Rhyme Judgment – Percent Correct			
Mean (SD)	92.3 (4.98)	76.3 (15.5)	$t(37) = 5.72$
Median [Min, Max]	92.7 [78.1, 100]	78.1 [41.5, 95.1]	$p < .001$
Flanker Incongruent Trials Accuracy (out of 20)			
Mean (SD)	20.0 (0.216)	19.2 (2.33)	$t(32) = 1.74$
Median [Min, Max]	20.0 [19.0, 20.0]	20.0 [7.00, 20.0]	$p = .09$
Towers of Hanoi – Levels Complete			
Mean (SD)	3.86 (0.354)	3.58 (0.561)	$t(51) = 2.52$
Median [Min, Max]	4.00 [3.00, 4.00]	4.00 [2.00, 4.00]	$p = .02$
Towers of Hanoi – Total Number of Moves on Levels 1 through 3			
Mean (SD)	13.7 (4.48)	14.8 (4.09)	$t(71) = -1.16$
Median [Min, Max]	11.0 [11.0, 30.0]	13.0 [11.0, 29.0]	$p = .25$

Predicting anomia trial-to-trial treatment accuracy and learning retention via performance factor analysis

Marzieh Alidadi^{1*}, William S. Evans², Peter Brusilovsky¹

¹ School of Computing and Information, University of Pittsburgh, Pittsburgh, PA, USA

² Department of Communication Sciences and Disorders, University of Pittsburgh, Pittsburgh, PA, USA

***Corresponding author, MAA1088@pitt.edu**

Introduction

While employing drill-based anomia treatment is effective, there is substantial individual variability in treatment outcomes (Quique et al., 2019). This underscores the importance of personalized approaches. Optimizing acquisition and retention necessitates understanding individual differences in severity and language profiles.

Machine learning and user modeling techniques, which have shown promise in educational domains (Chen et al., 2020), offer possible approaches for developing adaptive, aphasia-specific rehabilitation algorithms that dynamically personalize learning based on ongoing patient performance. However, these approaches have primarily been applied to novel learning in populations without brain damage. The current study applies machine learning approaches to predict trial-to-trial treatment performance and one-month treatment retention as a first step towards improved precision medicine.

Methods

This work utilizes the Performance Factor Analysis (PFA) framework (Pavlik et al., 2009) applied to data from a semantically-oriented anomia clinical trial (Evans et al., 2021). Baseline aphasia severity was measured by the Comprehensive Aphasia Test (CAT). Data included trial-level treatment naming accuracy and response times, and repeated naming probe assessment of trained words collected across experimental phases—baseline, treatment, and one-month follow-up—providing data to evaluate naming performance retention. These features were utilized to represent participants' severity and naming accuracy throughout the study.

Word-level features, including semantic category and production complexity, were retained. The primary outcome was naming accuracy on the first naming attempt per trial. Learning history was captured via cumulative counts of prior correct (s) and incorrect (f) responses for each participant-word pair. Temporal effects on retention were modeled using the time since the previous session and the time since the initial session. Baseline aphasia severity was included as an individual-level predictor. The PFA model used treatment data for training and probe data during follow-up to predict retention accuracy one month later.

Multiple models, such as Logistic Regression, Support Vector Machines, and XGBoost were trained on all possible feature combinations to identify the most informative predictors of naming accuracy. They were evaluated via accuracy, F1-score, and area under the curve (AUC).

Results

We evaluated machine learning models to predict naming accuracy in SSWA, using all combinations of features. Table 1 summarizes the performance metrics of the top models ranked by F1-score. The best-performing model was XGBoost, trained on aphasia severity, s, f, and temporal treatment variables, achieving an accuracy and F1-score of 83.1% in predicting one-month treatment retention.

To understand the contributions of predictors and the prevalence of algorithms, we analyzed all models achieving an F1-score above 0.80. Learning history variables were present in over 95% of these top-performing models, while response time and semantic treatment category were used less frequently. Support Vector Machines dominated the top models (41%), followed by Logistic Regression and Gradient Boosting, then XGBoost and Random Forest.

Conclusions

This study demonstrates that PFA is a promising approach for modeling and predicting treatment and retention performance in anomia rehabilitation. The results underscore the multifactorial nature of aphasia treatment response, highlighting the importance of integrating individual characteristics, word-level features, and temporal dynamics to enhance naming performance prediction.

References

- Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, 8, 75264–75278.
- Evans, W. S., Cavanaugh, R., Quique, Y., Boss, E., Starns, J. J., & Hula, W. D. (2021). *Playing with BEARS + SFA (Evans et al., 2021)*. 5413751 Bytes. <https://doi.org/10.23641/ASHA.14935812.V1>
- Pavlik, P. I., Cen, H., & Koedinger, K. R. (2009). Performance factors analysis—A new alternative to knowledge tracing. *Frontiers in Artificial Intelligence and Applications*, 200(1), 531–538.
- Quique, Y. M., Evans, W. S., & Dickey, M. W. (2019). Acquisition and Generalization Responses in Aphasia Naming Treatment: A Meta-Analysis of Semantic Feature Analysis Outcomes. *American Journal of Speech-Language Pathology*, 28(1S), 230–246.

Acknowledgments

This work is funded by NIH NIDCD 1R01DC019325.

Table 1. Performance Metrics of Top Predictive Models

Model	Features	Accuracy	F1-score	AUC	Precision	Recall	Log Loss
XGBoost	severity, s, f, last_treatment_time_difference, first_treatment_time_difference	0.83	0.83	0.85	0.81	0.94	0.51
Logistic Regression	participant, severity, response_time, s, f	0.82	0.82	0.86	0.81	0.94	0.53
XGBoost	participant, category, target, complexity_score, f, last_treatment_time_difference, first_treatment_time_difference	0.82	0.82	0.85	0.81	0.93	0.49
XGBoost	target, complexity_score, f, first_treatment_time_difference	0.82	0.82	0.84	0.81	0.93	0.47
Logistic Regression	participant, response_time, s, f, last_treatment_time_difference	0.82	0.82	0.86	0.81	0.93	0.49

Cognitive and Cognitive-Linguistic Interventions in Aphasia Rehabilitation: A Systematic Review of Treatment Approaches and Outcomes

Anum Amin^{1*}, Christie C. Duhigg¹, Sarah Walker¹, Rick Arenas¹, and Jessica D. Richardson¹

¹ Department of Speech and Hearing Sciences, University of New Mexico, Albuquerque, NM, USA

***corresponding author, aamin@unm.edu**

Introduction

Aphasia primarily manifests as a linguistic impairment. However, a growing body of evidence indicates that non-linguistic cognitive deficits, such as impairments in executive function (Murray, 2017), attention (Villard & Kiran, 2017), short-term and working memory (Potagas, Kasselimis & Evdokimidis, 2011), frequently co-occur with aphasia and can significantly influence language profiles and rehabilitation outcomes. While traditional aphasia therapy has demonstrated effectiveness, it has primarily concentrated on language-specific impairments, often overlooking these domain-general cognitive factors, which introduce a significant obstacle to the process of language recovery (Yao et al., 2020). In response, non-linguistic cognitive training for people with aphasia has gained increasing attention in recent years, underscoring its potential to support and enhance language recovery (Murray, Keeton & Karcher, 2006; Peach et al., 2019; Salis, Kelly & Code, 2015). Although cognitive training has shown potential for treating aphasia, its effectiveness varies across studies, and the optimal treatment approaches have yet to be established.

Building on evidence that language abilities engage brain regions involved in domain-general cognitive processing, this systematic review aims to investigate whether standalone cognitive training or combined cognitive-linguistic treatments improve language and/or cognitive outcomes in people with aphasia across all phases of recovery. Specifically, the review addresses three research objectives: (1) to identify the types of cognitive and cognitive-linguistic treatment approaches used for people with aphasia, excluding traditional language-based aphasia treatments; (2) to describe the outcome measures being used to evaluate treatment-induced changes in language and/or cognitive functions; and (3) to explore whether these interventions-standalone cognitive or combined cognitive-linguistic- lead to improvements in language, cognitive, and/or social outcomes for people with aphasia.

Method

A systematic search for article selection was conducted in April 2025 across seven databases: MEDLINE (Ovid), Embase, CINAHL, PsycINFO, PubMed, Web of Science, and the first 10 pages of Google Scholar. References were managed in Zotero and screened using Covidence software, a web-based systematic review screening tool (Covidence, 2025). After removing duplicates, 1,323 studies were screened at title/abstract and full-text levels by two independent reviewers. Sixteen studies met inclusion criteria: peer-reviewed, English-language intervention studies (1980–present)

involving adults with aphasia following acquired brain injury, across all recovery phases. Eligible designs included RCTs, quasi-experimental, cohort, case series, and single-case designs with experimental control. Interventions included standalone cognitive or combined cognitive-linguistic approaches, with language and/or cognitive outcomes. Studies without cognitive treatment components, involving PPA or non-aphasic participants, or limited to qualitative or descriptive designs, were excluded.

Results

Data extraction by two independent researchers is underway using a structured spreadsheet. Extracted variables include study design, participant demographics (age, aphasia type/severity, recovery phase, etiology), intervention characteristics (type, target components, delivery mode, dosage), and outcome measures (language, cognition, maintenance/generalization). Study conclusions and clinical implications are also being documented. Findings will be synthesized narratively and presented in tables. Interventions will be categorized as standalone cognitive or combined cognitive-linguistic, and sub-classified by cognitive domain (attention, memory, executive function, metacognition), with anticipated reporting of their effects on language and cognitive outcomes at the conference.

References

- Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia.
Available at www.covidence.org
- Murray, L. L., Keeton, R. J., & Karcher, L. (2006). Treating attention in mild aphasia: Evaluation of attention process training-II. *Journal of Communication Disorders*, 39(1), 37-61.
- Murray, L. (2017). Focusing attention on executive functioning in aphasia. *Aphasiology*, 31(7), 721-724.
- Peach, R. K., Beck, K. M., Gorman, M., & Fisher, C. (2019). Clinical outcomes following language-specific attention treatment versus direct attention training for aphasia: A comparative effectiveness study. *Journal of Speech, Language, and Hearing Research*, 62(8), 2785-2811.
- Potagas, C., Kasselimis, D., & Evdokimidis, I. (2011). Short-term and working memory impairments in aphasia. *Neuropsychologia*, 49(10), 2874-2878.
- Salis, C., Kelly, H., & Code, C. (2015). Assessment and treatment of short-term and working memory impairments in stroke aphasia: a practical tutorial. *International Journal of Language & Communication Disorders*, 50(6), 721-736.
- Villard, S., & Kiran, S. (2017). To what extent does attention underlie language in aphasia?. *Aphasiology*, 31(10), 1226-1245.
- Yao, J., Liu, X., Liu, Q., Wang, J., Ye, N., Lu, X., & Zhang, Y. (2020). Characteristics of non-linguistic cognitive impairment in post-stroke aphasia patients. *Frontiers in Neurology*, 11, 1038.

Acknowledgements

This work is being conducted under the supervision of Dr. Jessica D. Richardson and Dr. Cindy Gevarter, whose guidance throughout the development of this review is deeply appreciated. I would also like to thank Liz Cooper, the librarian at UNM, for her assistance

in developing search strategy; Christie C. Duhigg and Sarah Walker, doctoral students, for their support during the screening and data extraction phases. This project is not part of a symposium or workshop. No external funding was received for this study.

Do psycholinguistic variables predict alexic reading performance beyond their effects in typical readers?

Elizabeth J. Anderson^{1*}, Andrew T. DeMarco¹, Peter E. Turkeltaub^{1,2}

¹ Center for Brain Plasticity and Recovery, Departments of Neurology and Rehabilitation Medicine, Georgetown University Medical Center, Washington, DC, USA

² Research Division, MedStar National Rehabilitation Hospital, Washington, DC, USA

*corresponding author, ea880@georgetown.edu

Introduction

Alexia is an acquired reading disorder that often occurs following a left hemisphere stroke (Coslett & Turkeltaub, 2016). Relative deficits on particular word types are used to diagnosis process-specific reading impairments. However, even typical readers exhibit differences in performance across word types, despite generally high reading performance. Typical adults read low-imageability, low-frequency irregular words (e.g., *suave*, Strain & Hardman, 1999; Strain et al., 1995) more slowly and less accurately. It remains unclear whether individuals with alexia struggle with the same items as healthy participants but to a greater degree, or whether their reading patterns reflect distinct deficits that provide insight into the specific cognitive mechanisms damaged after stroke.

Methods

84 individuals with left hemisphere stroke-induced aphasia (39 females; mean age: 60.5 years, SD: 11.5 years) and 61 control participants (28 females; mean age: 60.5 years, SD: 11.5 years) completed a real word reading task in which they read aloud 200 monosyllabic words that varied in frequency, regularity, and imageability. We used linear mixed effects models to test the fixed effects of imageability, frequency, regularity, age, and education on the dependent variable efficiency (accuracy/RT) separately for controls and the stroke sample. We tested effects up to and including a three-way interaction between imageability, frequency, and regularity. We then estimated a second linear mixed effects model in just the stroke sample adding a fixed effect of average control efficiency per item to assess the effect of item difficulty based on control performance on alexic reading.

Results

In controls, results demonstrated significant 2-way interactions between imageability and both frequency ($p < .001$) and regularity ($p < .001$) as well as between frequency and regularity ($p < .001$). When not accounting for item-level control efficiency in the stroke sample, we observed significant 2-way interactions between imageability and regularity ($p < .001$) and frequency and regularity ($p < .001$). Control efficiency, once added, was a significant main effect ($p < .001$). The interaction between frequency and regularity disappeared, while the interaction between imageability and regularity remained significant ($p = .042$). Main effects of frequency ($p < .001$), regularity ($p < .001$), and imageability ($p < .001$) were present in all three models.

Conclusions

Item-level efficiency in controls, which can be thought of as normal item difficulty, accounts for a substantial proportion of performance in alexia, but psycholinguistic features of words also independently contribute above and beyond. This confirms that process-specific impairments do affect alexic reading performance, and that deficits do not simply reflect exaggerations of typical reading patterns observed in controls. The interaction of imageability and regularity reflects an exaggerated influence of imageability on irregular word reading in stroke survivors. This suggests an increased reliance on semantic knowledge for lexical reading. Future research will investigate individual differences in psycholinguistic effects in stroke survivors after accounting for item difficulty to clarify the neural and cognitive mechanisms underlying these effects. Understanding these patterns can inform the development of evidence-based stimulus selection in alexia evaluation and treatment.

References

- Coslett, H. B., & Turkeltaub, P. (2016). Acquired Dyslexia. In *Neurobiology of Language* (pp. 791–803). Elsevier.
- Strain, E., & Herdman, C. M. (1999). Imageability effects in word naming: An individual differences analysis. *Canadian Journal of Experimental Psychology / Revue Canadienne de Psychologie Expérimentale*, 53(4), 347–359.
- Strain, E., Patterson, K., & Seidenberg, M. S. (1995). Semantic effects in single-word naming. *Journal of Experimental Psychology: Language, Memory, and Cognition*, 21(4), 1140-1154.

Acknowledgments

This work was supported by the National Institute of Deafness and Communication Disorders of the National Institute of Health under grant T32DC019481, R01DC014960 and R01DC020446 to P.E.T. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The author wishes to thank the members of the Cognitive Recovery Lab. We also thank all of the study participants, without whom this research would not be possible.

Neural correlates of lexical activation and selection deficits in post-stroke aphasia

Elizabeth J. Anderson^{1,2} Preeti Rishi¹, and Stephanie K. Ries^{1,3*}

¹ Joint Doctoral Program in Language and Communicative Disorders, San Diego State University/University of California San Diego, San Diego, CA, USA

² Georgetown University Medical Center, Washington, DC, USA

³ School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, CA, USA.

*corresponding author, sries@sdsu.edu

Introduction

Lexical activation and selection, two complementary stages underlying lexical retrieval (Caramazza & Costa, 2000), can be independently impacted in stroke-induced aphasia, as shown in a recent case study (Nozari, 2019). In the current study, we tested whether this dissociation might be linked to lesion location. We hypothesized that damage in the posterior lateral temporal cortex (pLTC), which has been associated with lexical access (Dronkers et al., 2004; DeLeon et al., 2007), would result in a lexical activation deficit. By contrast, we expected that left prefrontal cortex (PFC) lesions that exclude the pLTC would be linked to a deficit in lexical selection, given the proposed role of the LPFC in semantic interference resolution (Piai et al., 2013; Schnur et al., 2006).

Methods

Twelve individuals with left-hemisphere stroke-induced lesions (mean age: 62.3 years, SD: 16.3 years) and 16 control participants (mean age: 63.8 years, SD: 11.2 years) participated in a Category Probe task, testing lexical activation, and a Miscue task, testing lexical selection, as in the case study by Nozari et al. (2019), and a Picture-Word Interference (PWI) task (Anderson et al., 2022). We separated individuals with aphasia into two groups based on lesion location (including vs. excluding the pLTC). In the Category Probe task, participants judged whether a probe noun shared a semantic category with any preceding nouns, with list length increasing based on performance. In the Miscue task, participants named images presented with either a correct onset cue (e.g., “T” on top of a picture of a tiger) or a taxonomically-related miscue (“T” on top of a picture of a lion). The PWI task tested participants' ability to name images in the context of unrelated and related distractor words.

Results

Individuals with lesions including the pLTC ($n = 7$) demonstrated lower scores on the Category Probe task ($p < .01$), produced more errors overall ($p < .0001$, particularly more omission errors, $p = .048$) on the Miscue Task, and were slower ($p < .01$) and less accurate ($p < .01$) on the picture-word interference task than individuals with lesions excluding the pLTC ($n = 5$). Overall, both groups of patients made more errors than control participants ($p_s < 0.001$).

To determine if this behavioral pattern based on lesion location is linked to differential activation and selection deficits, we used k-means clustering to divide participants into

two groups based on their Category Probe and Miscue task performance. Using Nozari (2019)'s criteria of performance on these tasks, we found that four out of five individuals with lesions excluding the pLTC were assigned as having a selection deficit. Individuals with pLTC lesions performed more inconsistently across tasks, making it difficult to classify them as strictly exhibiting either an activation or selection deficit. Activation deficits may have downstream effects on lexical selection given that lexical activation is necessary for selection to occur.

Conclusions

Lexical selection and activation deficits can dissociate to an extent based on lesion location. Indeed, individuals with LPFC lesions excluding the pLTC appear to be more likely to show lexical selection but not activation deficits. Individuals with lesions including the pLTC instead appear to show primarily lexical activation deficits with possible downstream effects on lexical selection.

References

- Anderson, E. J., Midgley, K. J., Holcomb, P. J., & Riès, S. K. (2022). Taxonomic and thematic semantic relationships in picture naming as revealed by Laplacian-transformed event-related potentials. *Psychophysiology*, 59(11), e14091.
- Caramazza, A., & Costa, A. (2000). The semantic interference effect in the picture-word interference paradigm: Does the response set matter? *Cognition*, 75(2), B51–B64. [https://doi.org/10.1016/S0010-0277\(99\)00082-7](https://doi.org/10.1016/S0010-0277(99)00082-7).
- DeLeon, J., Gottesman, R. F., Kleinman, J. T., Newhart, M., Davis, C., Heidler-Gary, J., Lee, A., & Hillis, A. E. (2007). Neural regions essential for distinct cognitive processes underlying picture naming. *Brain*, 130(5), 1408–1422. <https://doi.org/10.1093/brain/awm011>
- Dronkers, N. F., Wilkins, D. P., Van Valin, R. D., Redfern, B. B., & Jaeger, J. J. (2004). Lesion analysis of the brain areas involved in language comprehension. *Cognition*, 92(1–2), 145–177. <https://doi.org/10.1016/j.cognition.2003.11.002>
- Nozari, N. (2019). The dual origin of semantic errors in access deficit: Activation vs. Inhibition deficit. *Cognitive Neuropsychology*, 36(1-2), 31–53. <https://doi.org/10.1080/02643294.2019.1587397>
- Piai, V., Roelofs, A., Acheson, D. J., & Takashima, A. (2013). Attention for speaking: Domain-general control from the anterior cingulate cortex in spoken word production. *Frontiers in Human Neuroscience*, 7. <https://doi.org/10.3389/fnhum.2013.00832>
- Schnur, T., Schwartz, M., Brecher, A., & Hodgson, C. (2006). Semantic interference during blocked-cyclic naming: Evidence from aphasia☆. *Journal of Memory and Language*, 54(2), 199–227. <https://doi.org/10.1016/j.jml.2005.10.002>

Acknowledgments

This work was supported by the National Institute of Deafness and Communication Disorders of the National Institute of Health under grant 1F31DC020122 to E.A., 521DC016985 to S.R., National Science Foundation Grant 2143805 to S.R., 1T32DC019481 to P.E.T., and T32DC007361-16 supporting P.R. The content is solely the responsibility of the authors and does not necessarily represent the official views of

the National Institutes of Health nor the National Science Foundation. The author wishes to thank Dr. N. Nozari for invaluable advice on this project and the members of the Laboratory for the Brain Dynamics of Language for their assistance at various stages of this project. We also thank all of the study participants, without whom this research would not be possible.

SaTowards AI-based Evaluation of Spoken Picture Naming

Andrew J. Anderson^{1-3*}, Sara B. Pillay¹

¹Department of Neurology, Medical College of Wisconsin, Milwaukee, WI, 53226, USA

²Department of Biomedical Engineering, Medical College of Wisconsin, Milwaukee, WI, 53226, USA

³Department of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, 53226, USA

***corresponding author, andanderson@mcw.edu**

Introduction

Aphasia is a disorder that impairs language formulation and comprehension. Aphasia therapy typically involves biweekly in-clinic visits along with daily home exercises, often requiring people to practice speaking the names of objects presented in pictures. There is a critical gap in real-time automated systems to identify and provide feedback on speech errors during at-home practice sessions. Having this feedback could enable people to independently chart their progress and revise their exercise regimes. An effective speech evaluation system could also reduce clinical assessment time and increase diagnostic consistency. We present work in progress that applies current AI-technologies to recognize spoken picture names in aphasia and provide immediate automated feedback on speech errors.

Methods

An automated picture naming evaluation system was built by integrating AI speech and language modeling approaches and run on a GPU-powered laptop (*Figure 1*). The system operates by (1) displaying an object image, (2) recording audio speech, (3) transcribing audio as text using three parallelized speech recognition models (Whisper-large-v3, Whisper-tiny, and wav2vec2-large-960h-lv60). To enable phonetic evaluation, the text is re-represented as a phoneme sequence using “Phonemizer” with EspeakBackend. To quantify pronunciation errors, “Phoneme Error Rate” is computed against the target name’s phoneme sequence (the number of insertions, deletions or substitutions in the recognized sequence, divided by the total number of target phonemes). In case of phonetic errors, the recognized text undergoes a semantic analysis to estimate if the speech input corresponds to a word with related meaning (e.g. saying “sweep” in response to a broom image). Semantic relatedness is estimated by representing the recognized and target name as GloVe semantic word embedding vectors and computing the correlation between vectors. An arbitrary threshold of $r \geq 0.3$ was used to identify semantically related words.

User feedback is provided within ~3s of the spoken response. In case of a semantically related naming error, both the speech audio input and the target name are replayed and simultaneously displayed as text. Otherwise, the user is informed of the Phoneme Error Rate (transformed to a percentage correct), and the target picture name. In both cases, the target pronunciation was synthesized as audio using the text-to-speech model: SpeechT5_tts.

Results

The pilot AI system was tested on two stroke survivors with speech production deficits. Each participant named a total of 80 object pictures. Participant responses were manually evaluated by a human expert for comparison.

For participant 1, the human\AI estimated 48\49 correct naming responses, with an overlap of 46. Correct responses were estimated to be spoken 2.6s\2.4s post picture display, on average. The AI appeared more prone to identify naming errors as semantically related to the target name (7\17). For participant 2, the human\AI estimated 74\73 correct responses (73 overlap). Correct responses were spoken at a mean latency of 1.9s\1.7s. Both human and AI estimated that all naming errors were semantically related to the target names. Human evaluation took over two hours for each participant.

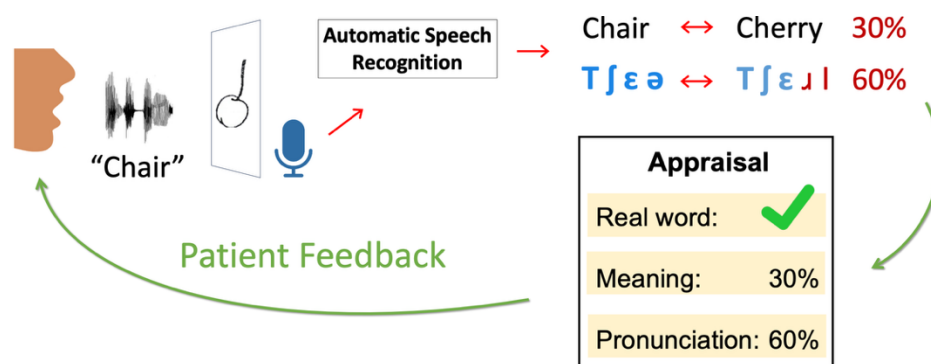
Conclusions

Automated systems to provide users real-time feedback on picture naming speech errors are a plausible future prospect.

Acknowledgments

This study was funded by an Imagine More Award from the Neuroscience Research Center, Medical College of Wisconsin.

Figure 1. Speech and Language Appraisal System



Assessing Cognition in Bilingual Aphasia: A Scoping Review

Javad Anjum^{1*}, Manaswita Dutta², Lidiya Khoroshenkikh², and Brooke Elizabeth Apple¹

¹ Department of Communication Sciences and Special Education, University of Georgia, Athens, GA, USA

² Department of Speech and Hearing Sciences, Portland State University, Portland, OR, USA

***corresponding author, anjum@uga.edu**

Introduction

The assessment of cognition in aphasia is crucial, as co-occurring cognitive impairments can significantly impact language abilities, rehabilitation outcomes, prognosis, and life participation (Diedrichs et al., 2022; Dutta et al., 2023; 2024). Although the relationship between cognition and aphasia is increasingly acknowledged, cognitive assessment in bilingual persons with aphasia (BPWA) remains notably under-researched and underutilized in clinical practice (Lorenzen & Murray, 2008). This scarcity underscores a broader inequity affecting culturally and linguistically diverse populations (Grasso et al., 2023) and highlights an imminent need for the development and adaptation of psychometrically-sound and culturally responsive clinical cognitive assessment tools for BPWA, especially as global bilingual populations continue to grow. The present scoping review aims to systematically examine the existing empirical literature and synthesize the evidence on cognitive assessments used with BPWA.

Methods

This scoping review was conducted in accordance with the latest Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). A systematic search was conducted to identify studies published between 2000 and 2025 in established databases available from university libraries, PubMed, and Google Scholar (Figure 1). Various Boolean and root word search combinations of the following string was used: ("bilingual*" OR "multilingual*") AND "aphasi*" AND ("cognit*" OR "memory" OR "attention*" OR "executive" OR "speed" OR "assess*"). The inclusion criteria included English-language journal articles reporting on cognitive abilities—specifically processing speed, attention, memory, executive function/cognitive control—in bilingual or multilingual PWA. Articles were excluded if they were reviews, did not report information related to cognitive tasks or assessments, focused solely on monolinguals, or addressed progressive neurological conditions (e.g., dementia). The authors independently screened the records for titles, abstracts, and full-text articles. Data extraction and validation was completed through regular meetings and consensus across the domains of study objectives, participant characteristics, and cognitive assessments used. Each cognitive assessment was classified according to the measured constructs based on the International Classification of Functioning, Disability and Health (ICF) framework (WHO, 2017).

Results

A total of 30 articles were eligible for inclusion - most of which were quasi-experimental studies (n = 16) that compared BPWA to neurotypical bilinguals. There was a notable increase in the number of articles reporting on this topic in the past 10 years, with 73% of articles published after 2015. Most studies aimed to characterize cognitive abilities in BPWA, most commonly using nonverbal executive functioning tasks (n = 28) whereas a subset of them assessed cognition in the context of aphasia treatment (n = 11). A majority of the studies reported using experimental cognitive tasks (e.g., lab developed Flanker task) in addition to specific subtests of standardized cognitive assessments (Table 1).

Conclusions

The scoping review highlights significant variability in cognitive assessments used with BPWA, with a disproportionate focus on executive function and limited evidence on domains such as memory and attention. The findings reveal a lack of rigorous, culturally responsive tools, especially for non-English speakers, underscoring the need for future research on identifying and developing comprehensive, psychometrically-sound assessments to support equitable and effective care for BPWA.

References

- Diedrichs, V. A., Jewell, C. C., & Harnish, S. M. (2022). A scoping review of the relationship between nonlinguistic cognitive factors and aphasia treatment response. *Topics in Language Disorders*, 42(3), 212–235. <https://doi.org/10.1097/TLD.0000000000000290>
- Dutta, M., Murray, L. L., & Stark, B. C. (2023). Assessing the integrity of executive functioning in chronic aphasia. *Aphasiology*, 37(4), 869–906. <https://doi.org/10.1080/02687038.2022.2049675>
- Dutta, M., Murray, L. L., & Stark, B. C. (2024). The relationship between executive functioning and narrative language abilities in aphasia. *American Journal of Speech-Language Pathology*. Advance online publication. https://doi.org/10.1044/2024_AJSLP-23-00314
- Grasso, S. M., Wagner Rodríguez, C. A., Montagut Colomer, N., Marqués Kiderle, S. K., Sánchez-Valle, R., & Santos Santos, M. Á. (2023). Bilingual primary progressive aphasia: A scoping review of assessment and treatment practices. *Journal of Alzheimer's Disease*, 96(4), 1453–1476. <https://doi.org/10.3233/JAD-230673>
- Lorenzen, B., & Murray, L. L. (2008). Bilingual aphasia: A theoretical and clinical review. *American Journal of Speech-Language Pathology*, 17(3), 299–317. [https://doi.org/10.1044/1058-0360\(2008/026\)](https://doi.org/10.1044/1058-0360(2008/026))
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
- World Health Organization. (2017). *International classification of functioning, disability, and health*. World Health Organization.

Acknowledgments

The authors extend their gratitude to the participants whose data were included in this study, as well as to the researchers who collected and contributed the data to the AphasiaBank shared database.

Figure 1. PRISMA flow diagram

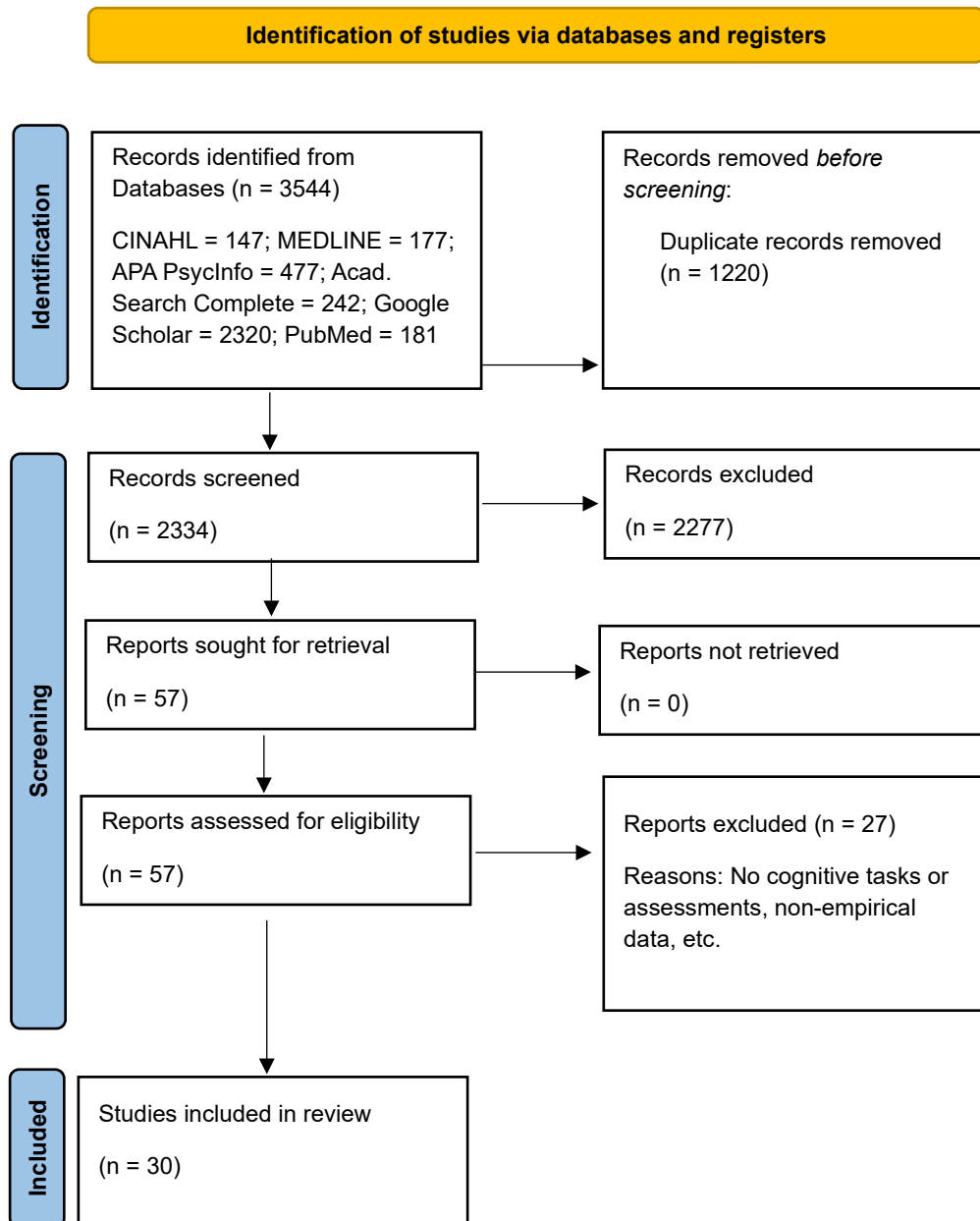


Table 1. Preliminary summary of studies assessing cognition in bilinguals with aphasia.

Authors	Bilingual PWA	First language (L1)	Second language (L2)	Third language (L3)	Aphasia characteristics	Cognitive assessments used
Bihovsky et al. (2024a)	20	Russian	Hebrew	N/A	<u>Aphasia severity range:</u> Mild-severe aphasia <u>Aphasia types:</u> Mixed (n=5); Anomic (n=9); Motor (n=4); Conductive (n=1); Sensory (n=1)	Standard Progressive Matrices, Flanker, Visual span – the “Corsi” subtest from the PEBL battery, Sorting – the “bcst” subtest from the PEBL battery, Digit span, Stroop, Modified Listening Span
Bihovsky et al. (2024b)	1	Hebrew	English	N/A	Moderate nonfluent aphasia: moderate difficulties in language production in L1-Hebrew and continuing to exhibit severe difficulties in language production in L2-English	Standard Progressive Matrices, Flanker, Visual span “Corsi” subtest from the PEBL battery, Sorting “bcst” subtest PEBL), Digit span, Stroop, Backward repetition of numbers
Gray et al. (2024)	1	Russian	English	N/A	Broca’s aphasia	CLQT, TONI
Bihovsky et al. (2023)	20	Russian/Hebrew	Hebrew/Russian	N/A		Standard Progressive Matrices, Flanker , Visual span test - the “Corsi” subtest (PEBL battery), Sorting “bcst” subtest (PEBL battery), Digit span, Stroop, Modified listening span from the FriGvi battery

Masson-Trottier et al. (2022)	4	French	English	N/A	Par 1 = Moderate-severe anomic aphasia Par 2 -mild-moderate Broca's aphasia Par 3 = mild to moderate anomic aphasia Par 4 -moderate transcortical motor aphasia	MoCA, CASP, Flanker
Carpenter et al. (2021)	35	Spanish	English	N/A	L1 WAB-AQ range = 21 - 98.2 <u>Aphasia types:</u> Anomic (n=14); Broca's (n=6); Wernicke's (n=2), Conduction (n=3); NA (n=10) L2 WAB-AQ range = 16.4 – 91 <u>Aphasia types:</u> Anomic (n=5); Broca's (n=10); Wernicke's (n=3), Conduction (n=6); Global (n=2); NA (n=9)	RCPM subtest of the WAB-R, Category generation, Letter fluency
Dash et al. (2020)	10	French	English	N/A	<u>Aphasia type:</u> Anomic (n=6); Broca's (n=2); Transcortical motor aphasia (n=2)	MoCA, ANT

Carpenter et al. (2020)	13	Spanish/English	English/Spanish	N/A	NR	RCPM subtest of the WAB-R, Category generation, letter fluency
Patra et al. (2020)	8	Bengali	English	N/A	<u>Aphasia severity range:</u> Mild-severe aphasia <u>Aphasia type:</u> Broca's (n=7); Transcortical Motor aphasia (n=1)	Stroop, Trail Making Test, Backward digit span
Gray et al. (2020)	12	Spanish	English	N/A	BAT receptive language composite (range) = 21-95% BAT expressive language composite (range) = 0-100%	CLQT, Language Control Task, Semantic Control Task, Nonverbal task
Dekhlyar et al. (2020)	18	Spanish	English	N/A	BAT and BNT average scores provided	CLQT - symbol cancellation, symbol trails, design generation, and mazes sub-Tests, Nonlinguistic Triad Task
Paplikar et al. (2019)	38	Telugu/Dakkhini	Hindi/ English	N/A	ACE-R Language Domain Score mean (SD) = 14.4(11.3)	ACE-R

Gray & Kiran (2019)	13	Spanish	English	N/A	BAT average scores provided	CLQT, Linguistic and nonlinguistic Flanker, Linguistic and nonlinguistic triad task
Calabria et al. (2019)	11	Catalan	Spanish	N/A	<u>Aphasia severity range:</u> mild to moderate (WAB-R AQ = 55.6 - 84.5) <u>Aphasia type:</u> Anomic (n=8); Wernicke's (n=2); Conduction (n=1)	Flanker
Faroqi-Shah et al. (2018)	20	English/ Tamil	English, Russian, French, Hungarian, Spanish	N/A	BWPA (English-dominant) = Broca's (n=3); Anomic (n=6); Other (n=1) BWPA (Tamil-English) = Broca's (n=8); Other (n=2)	Stroop
Van der Linden et al. (2018a)	15	Dutch	French	English	Average %lie AAT/CAT (L1) range = 10-93.80 Average %tile AAT/CAT (L2) range = 21.2-91.20	Flanker
Van der Linden et al. (2018b)	1	French	English	N/A	Severe aphasia (differential aphasia)	Flanker
Penn et al. (2017)	10	"South African Language"	English	N/A	Severe (n=8); Broca's (n=2)	N-back, VicStroop, WCST, Number-Letter Task

Gray & Kiran (2016)	10	Spanish/English	English/Spanish	N/A	BAT average scores provided	CLQT, Flanker
Lee et al. (2016)	1	Japanese	Korean	N/A	Broca's aphasia.	Digit span forward and backward, Visual span forward and backward, Continuous Performance Test, Rey-O Complex Figure Test, TMT WCST, RCPM
Marini et al. (2016)	1	Romanian	Italian	N/A	Mild fluent aphasia	TMT, Spatial Span Test, Spatial Learning Task, Verbal Span Test, Rey's 15-word Immediate and Delayed Recall, RCPM, TOL, Phonemic fluency task
Keane & Kiran (2015)	1	Amharic	English	French	BAT average scores provided	CLQT, Flanker
Dash & Kar (2014)	4	Par 1- Telugu, Par 2- Urdu/Hindi, Par 3-Telugu, Par 4- Hindi/Urdu	English	Par 1,2- Kannada Hindi, Par 3- Telugu,Hindi, Par 4-Hindi	Par 1 = anomic aphasia Par 2 = anomic aphasia Par 3 = Broca's aphasia Par 4 = anomic aphasia	Nonverbal Negative Priming, Linguistic and Nonlinguistic Flanker
Kong et al. (2014)	1	Cantonese	English	Mandarin	Fluent, Wernicke's aphasia	Raven's Standard Progressive Matrices, CLQT – Symbol Trails, Modified Stroop, WCST

Verreyt et al. (2013)	1	French	Dutch	N/A	Differential thalamic aphasia (with better language in L1)	COWAT, RCPM, Flanker
Adrover-Roig et al. (2011)	1	Basque	Spanish	N/A	Severe fluent aphasia	Verbal and semantic fluency, Forward and Backward Digit Span, Stroop, TMT
Green et al. (2011)	1	German	English	Spanish	BAT and CAT administered	Stroop, ANT -Nonverbal Flanker, Raven's Progressive Matrices
Penn et al. (2010)	2	English	Afrikaans	N/A	Par 1 = Conduction; Par 2 = Anomic	Stroop, TMT, Self-Ordered Pointing Test, Complex Figures, WCST, TOL, Raven's Progressive Matrices, Five Point Test, Design Fluency
Green et al. (2010)	2	French, Spanish	English	N/A	BAT and CAT administered	Raven's Progressive Matrices, Stroop, Flanker
Kohnert et al. (2004)	1	Spanish	English	N/A	Severe transcortical motor aphasia	Flanker, Card sorting

Note. N/A = Not applicable; NR = Not reported; Par = Participant; ACE-R = Addenbrooke's Cognitive Examination – Revised; ANT = Attention Network Test (Fan et al., 2002; 2005); BAT = Bilingual Aphasia Test (<https://www-mcgill-ca.proxy.lib.pdx.edu/linguistics/research/bat>); BNT = Boston Naming Test (Kaplan et al., 2010); CASP = Cognitive Assessment scale for Stroke Patients; CAT = Comprehensive Aphasia Test (Swinburn et al., 2004); CLQT = Cognitive-Linguistic Quick Test (Helm-Estabrooks et al., 2001); COWAT = Controlled Oral Word Association Test; FriGvi = Friedmann Gvion battery for assessment of phonological working memory (Friedmann & Gvion, 2002); MoCA = Montreal Cognitive Assessment (Nasreddine et al., 2005); WAB-AQ = Western Aphasia Battery-Revised Aphasia Quotient (Kertesz, 2007); PEBL = Psychology Experiment Building Language (Mueller & Piper, 2014); RCPM = Raven's Colored Progressive Matrices; TOL = Tower of London (Shallice, 1982); TONI = Test of Nonverbal Intelligence (Brown et al., 2010); TMT = Trail Making Test (Reitan, 1992); WCST = Wisconsin Card Sorting Test (Grant & Berg, 1948).

Prosody function after stroke: evidence from a classification and an imitation tasks

Giada Antonicelli^{1,2}, Karen Arellano^{1,2}, Nerea Gorostiola^{1,2}, Pia Hembach³ & Simona Mancini^{1,4}

¹Basque Center on Cognition Brain and Language (BCBL), Donostia-San Sebastián, Spain

²University of the Basque Country (UPV/EHU), Bilbao, Spain

³RWTH Aachen University, Aachen, Germany

⁴Ikerbasque, Basque Foundation for Science, Bilbao, Spain

***corresponding author, g.antonicelli@bcbl.eu**

Introduction

Prosody comprehension is a complex process that requires to perceive sound, extract relevant acoustic features and integrate them into a coherent percept to be compared with stored intonation representations. Superior temporal areas, basal ganglia, and frontal regions are crucial interconnected hubs for intonation processing (Grandjean, 2021; Sammler et al., 2015). While temporal areas are the locus of acoustic perception and semantic representations, the role of other implicated regions is less clear, as is hemispheric lateralization. Prosody comprehension impairments have been observed after brain damage to either hemisphere (Ukaegbe et al., 2022), although the right temporal cortex seems to be especially sensitive to slow spectral modulations involved in prosody (Oderbolz et al., 2025).

Methods

To contribute evidence to such debate, we recruited 16 stroke survivors (days post-stroke = 34.81 ± 9.24), presenting with either a right-hemisphere (N=7, involving frontal areas, basal ganglia, thalamus and temporal and parietal regions) or a left hemisphere lesion (N=9, involving frontal areas, basal ganglia and thalamus). They were tested on a prosody classification task with two conditions, sentences and sequences of monosyllables. Their responses were compared to those of 15 healthy controls. Participants' details are provided in Table 1. To better characterize possible prosody classification deficits, we also analyzed responses from an imitation task on the same stimuli, in which participants mimicked the intonation they heard. Classification performance was measured based on response accuracy (correct, incorrect), while imitation quality was operationalized as the acoustic distance from the target, determined via both human rating and dynamic time warping.

Results

Crawford's tests revealed that seven stroke survivors had average accuracy below three standard deviations from the controls' mean in both conditions, accompanied by significantly poorer imitation performance. Of these, three of them had a lesion in left frontal regions, one in the left thalamus, one in the left basal ganglia, one in left fronto-parietal and one in right frontal regions. Seven brain-damaged participants showed

anomalous responses only in the imitation task. Out of those, five had right hemisphere lesions (one temporal, one parietal, two frontal, one in the basal ganglia), while two had damage in the left basal ganglia and the thalamus, respectively. One stroke survivor with a small right thalamus lesion was not different from controls. These results suggest that left frontal lesions were associated with reduced performance in both prosody classification and imitation, while right frontal regions only in one out of three cases. As for condition effects, all basal ganglia lesions were linked to deficits in the monosyllabic condition, while poor performance in the sentence condition was evident in individuals with frontal, temporal and parietal lesions, regardless of hemisphere. For a quick overview of the results, see Figure 1.

Conclusions

Our observations support left frontal regions as a ‘control panel’ of prosody processing that integrates percepts during comprehension and plans intonation modulations during production. In line with existing findings, basal ganglia might support lower-level motor representations, such as the ones involved in rhythm perception/generation. In our results, they were particularly linked to the monosyllabic condition, characterized by a more rhythmic profile compared to the sentence condition. Future work should include a wider sample of participants and lesions and explore the relationship between prosody comprehension/imitation and meaningful prosody generation.

References

- Grandjean, D. (2021). Brain Networks of Emotional Prosody Processing. *Emotion Review*, 13(1), Article 1. <https://doi.org/10.1177/1754073919898522>
- Oderbolz, C., Poeppel, D., & Meyer, M. (2025). Asymmetric Sampling in Time: Evidence and perspectives. *Neuroscience & Biobehavioral Reviews*, 171, 106082. <https://doi.org/10.1016/j.neubiorev.2025.106082>
- Sammler, D., Grosbras, M.-H., Anwender, A., Bestelmeyer, P. E. G., & Belin, P. (2015). Dorsal and Ventral Pathways for Prosody. *Current Biology*, 25(23), 3079–3085. <https://doi.org/10.1016/j.cub.2015.10.009>
- Ukaegbe, O. C., Holt, B. E., Keator, L. M., Brownell, H., Blake, M. L., & Lundgren, K. (2022). Apraxia Following Focal Brain Damage: What’s Right and What’s Left? *American Journal of Speech-Language Pathology*, 31(5S), Article 5S. https://doi.org/10.1044/2022_AJSLP-21-00302

Acknowledgments

This research is supported by the Basque Government through the BERC 2022-2025 program and Funded by the Spanish State Research Agency through BCBL Severo Ochoa excellence accreditation CEX2020-001010/AEI/10.13039/501100011033 and through project CEX2020-001010-S-21-5 funded by the Spanish State Research Agency and acronym AEI.

Figure 1. Stroke survivors' performance in the two tasks relative to controls' average (black line). Dot size is proportional to lesion size. For space reasons, we have only included one measure of acoustic distance (global distance) for one feature (envelope).

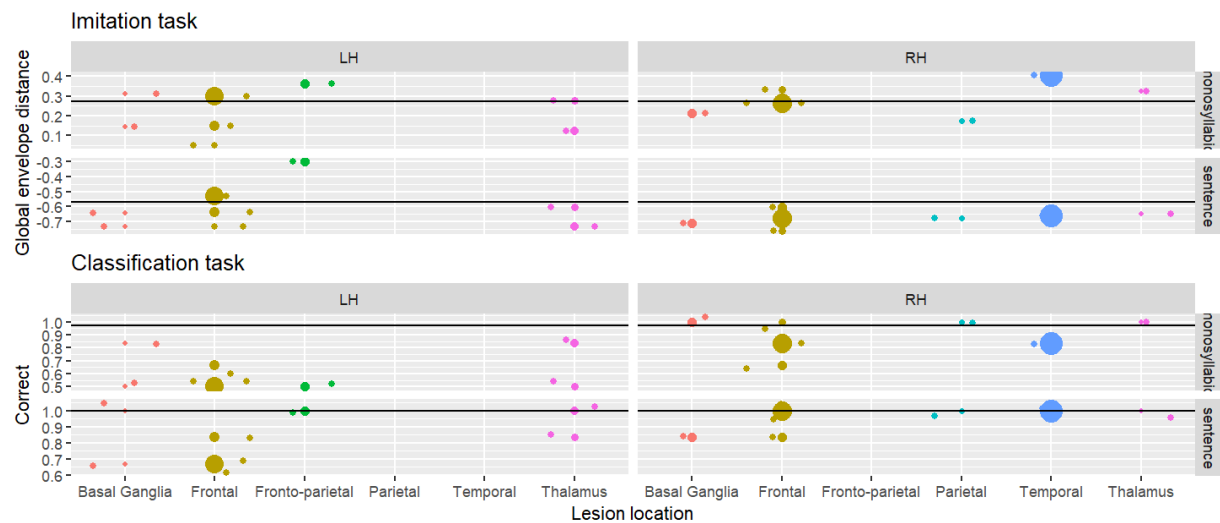


Table 1. Participants' demographics

Age	Sex	Years of education	Days after stroke	Group	Lesion volume	Lesion location
66	M	10	16	LH	3.55	Fronto-parietal
66	M	32	31	LH	2.25	Fronto-parietal
71	M	8	44	LH	0.39	Frontal
46	F	9	32	LH	16.77	Frontal
67	F	12	31	LH	0.04	Basal Ganglia
73	M	7	33	LH	0.91	Thalamus
59	F	11	45	LH	3	Frontal
52	M	13	31	LH	1.10	Thalamus
57	M	21	38	LH	0.05	Basal Ganglia
56	F	10	39	RH	0.92	Frontal
54	M	15	56	RH	2.03	Frontal
55	M	13	29	RH	30.39	Temporal
52	M	11	25	RH	0.02	Thalamus
61	M	9	35	RH	1.97	Basal Ganglia

65	M	11	45	RH	19.44	Frontal
54	M	16	27	RH	0.24	Parietal
61	F	17	NA	NBD	0	NA
71	M	15	NA	NBD	0	NA
65	M	16	NA	NBD	0	NA
64	F	17	NA	NBD	0	NA
64	M	13	NA	NBD	0	NA
54	M	19	NA	NBD	0	NA
70	M	28	NA	NBD	0	NA
65	M	16	NA	NBD	0	NA
60	M	20	NA	NBD	0	NA
67	F	17	NA	NBD	0	NA
39	M	17	NA	NBD	0	NA
50	M	25	NA	NBD	0	NA
50	M	16	NA	NBD	0	NA
56	M	12	NA	NBD	0	NA
61	M	25	NA	NBD	0	NA

Improving Lexicosemantic Impairments in People with Post-stroke Aphasia using Repetitive Transcranial Magnetic Stimulation Targeting the Right Anterior Temporal Lobe

Sophie Arheix-Parras^{1*}, Sidney Crouse¹, Sophia Moore¹, and Rutvik H. Desai^{1,2}

¹ Department of Psychology, University of South Carolina, Columbia (South Carolina), USA

² Institute for Mind and Brain, College of Arts and Sciences, Columbia (South Carolina), USA

***corresponding author, sophie.arheix-parras@sc.edu**

Introduction

Repetitive Transcranial Magnetic Stimulation (rTMS) is a non-invasive brain stimulation that can enhance aphasia recovery (Arheix-Parras et al., 2021). Most studies in persons with post-stroke aphasia (PWA) target the right Inferior Frontal Gyrus using inhibitory rTMS. However, this approach does not account for the variability in clinical profiles, lesion sizes and sites among PWA. Some authors have highlighted the limitations of this approach, given the complexity of language processes and the multiple paths for aphasia recovery (Stefaniak et al., 2022). PWA may experience difficulties such as anomia or produce semantic errors due to lexicosemantic impairments (Hillis & Caramazza, 1995). Lexicosemantic processes involve a large brain network that includes the Anterior Temporal Lobe (ATL) (Binder et al., 2009). Although the exact role of the ATL in lexicosemantic processes is still debated (Lambon Ralph et al., 2017; Desai & Riccardi, 2021), we propose that it is a promising target for rTMS in PWA suffering from lexicosemantic impairments to improve language processes. We hypothesize that stimulating the ATL with rTMS will engage the connected network through intra- and inter-hemispheric connectivity, including the ventral semantic stream (Duffau et al., 2014; Ridding & Rothwell, 2007).

Methods

In a Single-Case Experimental Design (Krasny-Pacini & Evans, 2018), we aim to include three PWA with lexicosemantic impairments. Each participant will perform four linguistic tasks (Auditory and Picture Naming, Picture-Word Matching task, Lexical Decision and Semantic Decision tasks), five times a week for one or two weeks, to establish baseline scores for each participant. Then, each participant will receive continuous inhibitory Theta Burst Stimulation targeting the right ATL, five times a week for two weeks. After each rTMS session, participants will perform all linguistic tasks. A follow-up measurement will be taken one month after the end of the study. The study is still ongoing, with P1 having completed all sessions, P2 still needing to perform the follow-up session, and P3 currently being recruited.

Results

After stimulation, P1 showed significant improvement in the Auditory and Picture Naming tasks with an increase in accuracy and a decrease in reaction time. We also observed a

decrease in reaction time for the Semantic Decision and Picture-Word Matching tasks. For P2, results showed an improvement in Semantic Decision in terms of accuracy and reaction time, as well as a decrease in Picture-Word Matching and Lexical Decision reaction time (Figure 1 and Table 1).

Conclusions

This study aligns with previous findings about the role of ATL in lexicosemantic processes (Desai & Riccardi, 2021). By stimulating the ATL, we suggest that rTMS impacts ventral pathways by affecting areas linked to the ATL, inducing a specific improvement in lexical retrieval processes (Duffau et al., 2014; Ridding & Rothwell, 2007). This study also highlights the possibility of choosing the cortical target for rTMS based on the clinical profile of the participant, making it more accessible to clinicians (Arheix-Parras et al., 2024). Incorporating rTMS into clinical practice could be based on a combination of literature data (cortical target selection, stimulation parameters) and practitioner expertise (contraindications, side effects management).

References

- Arheix-Parras, S., Barrios, C., Python, G., Cogné, M., Sibon, I., Engelhardt, M., Dehail, P., Cassoudealle, H., Moucheboeuf, G., & Glize, B. (2021). A systematic review of repetitive transcranial magnetic stimulation in aphasia rehabilitation: Leads for future studies. *Neuroscience and Biobehavioral Reviews*, 127, 212-241. <https://doi.org/10.1016/j.neubiorev.2021.04.008>
- Arheix-Parras, S., Franco, J., Siklafidou, I., Villain, M., Rogue, C., Python, G., & Glize, B. (2024). Neuromodulation of the Right Motor Cortex of the Lips With Repetitive Transcranial Magnetic Stimulation to Reduce Phonological Impairment and Improve Naming in Three Persons With Aphasia: A Single-Case Experimental Design. *American Journal of Speech-Language Pathology*. https://doi.org/10.1044/2024_AJSLP-23-00215
- Binder, J. R., Desai, R. H., Graves, W. W., & Conant, L. L. (2009). Where Is the Semantic System? A Critical Review and Meta-Analysis of 120 Functional Neuroimaging Studies. *Cerebral Cortex* (New York, NY), 19(12), 2767-2796. <https://doi.org/10.1093/cercor/bhp055>
- Desai, R. H., & Riccardi, N. (2021). Cognitive Neuroscience of Language. In X. Wen & J. R. Taylor (Eds.), *The Routledge Handbook of Cognitive Linguistics* (1 ed., pp. 615-642). Routledge.
- Duffau, H., Moritz-Gasser, S., & Mandonnet, E. (2014). A re-examination of neural basis of language processing: proposal of a dynamic hodotopical model from data provided by brain stimulation mapping during picture naming. *Brain and Language*, 131, 1-10. <https://doi.org/10.1016/j.bandl.2013.05.011>
- Krasny-Pacini, A., & Evans, J. (2018). Single-case experimental designs to assess intervention effectiveness in rehabilitation: A practical guide. *Annals of Physical and Rehabilitation Medicine*, 61(3), 164-179. <https://doi.org/10.1016/j.rehab.2017.12.002>
- Lambon Ralph, M. A., Jefferies, E., Patterson, K., & Rogers, T. T. (2017). The neural and computational bases of semantic cognition. *Nat Rev Neurosci*, 18(1), 42-55. <https://doi.org/10.1038/nrn.2016.150>

Ridding, M. C., & Rothwell, J. C. (2007). Is there a future for therapeutic use of transcranial magnetic stimulation? *Nature Reviews Neuroscience*, 8(7), 559-567. <https://doi.org/10.1038/nrn2169>

Stefaniak, J. D., Geranmayeh, F., & Lambon Ralph, M. A. (2022). The multidimensional nature of aphasia recovery post-stroke. *Brain*, 145(4), 1354-1367. <https://doi.org/10.1093/brain/awab377>

Acknowledgments

This research was supported by the Barbara Martin Award, also co-sponsored by the Academy of Aphasia, whose generous funding significantly contributed to the completion of this study.

Figure 1. Left (red): accuracy during the Auditory and Picture Naming task. Right (green): reaction time during the Semantic Decision task. The dashed line represents the mean baseline, and the colored envelope indicates ± 2 SD from the mean.

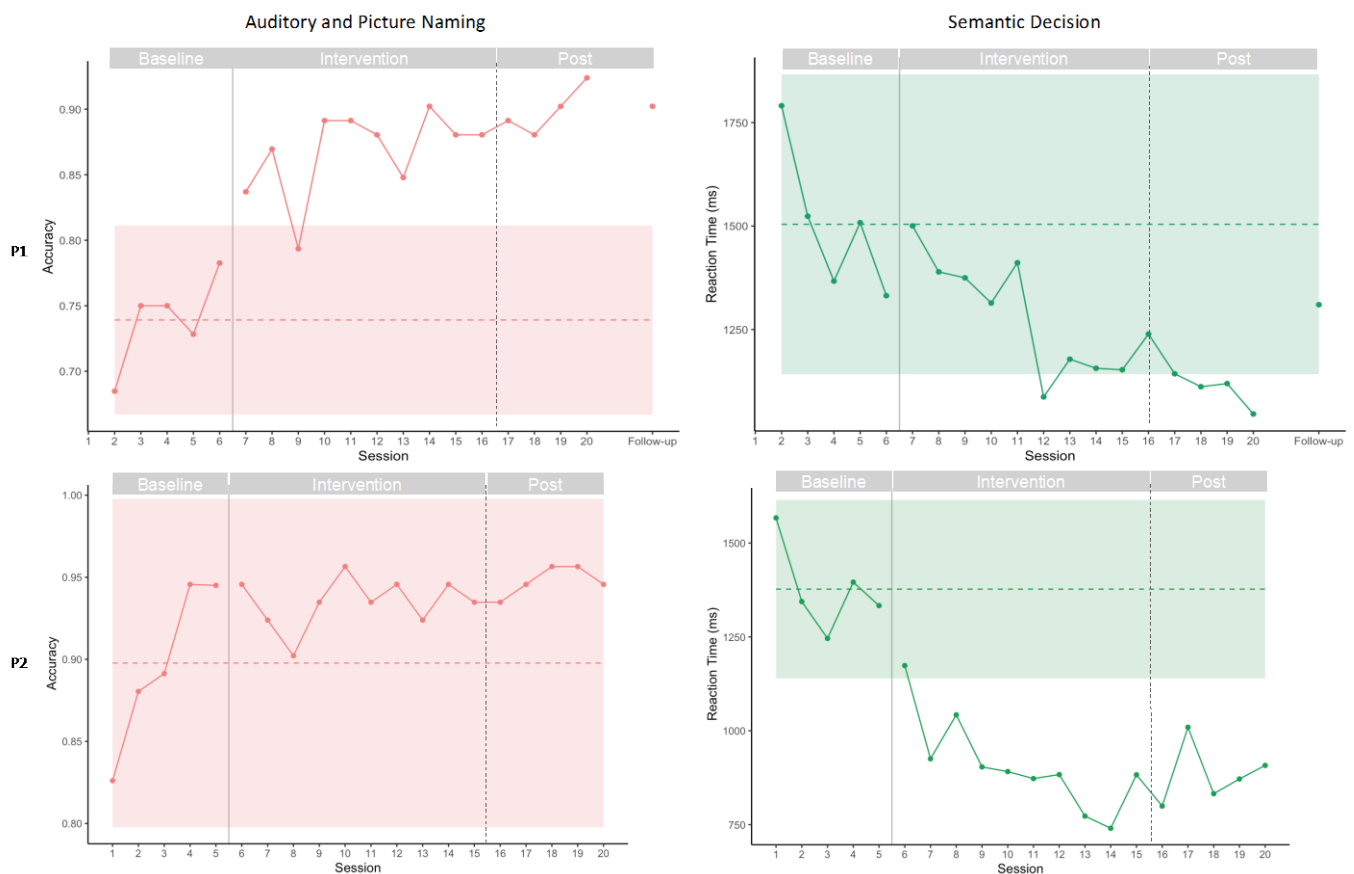


Table 1. Tau statistical analyses for the Auditory and Picture Naming, Picture-Word Matching, Lexical Decision, and Semantic Decision tasks. Scores in bold are statistically significant.

Task	Measure	Effect size
Auditory and Picture Naming	Accuracy	P1: Tau = 0.661, p = 0.001 (SE_{Tau} = 0.243) P2: Tau = 0.378, p = 0.068 (SE _{Tau} = 0.293)
	RT	P1: Tau = -0.475, p = 0.018 (SE_{Tau} = 0.285) P2: BC Tau = -0.142, p = 0.485 (SE _{Tau} = 0.313)
Picture-Word Matching	Accuracy	P1: ceiling effect P2: ceiling effect
	RT	P1: Tau = -0.628, p = 0.001 (SE_{Tau} = 0.246) P2: Tau = -0.633, p = 0.001 (SE_{Tau} = 0.245)
Lexical Decision	Accuracy	P1: Tau = -0.083, p = 0.708 (SE _{Tau} = 0.315) P2: Tau = 0.061, p = 0.791 (SE _{Tau} = 0.316)
	RT	P1: Tau = -0.237, p = 0.232 (SE _{Tau} = 0.307) P2: Tau = -0.491, p = 0.012 (SE_{Tau} = 0.276)
Semantic Decision	Accuracy	P1: Tau = 0.387, p = 0.057 (SE _{Tau} = 0.299) P2: Tau = 0.399, p = 0.044 (SE_{Tau} = 0.290)
	RT	P1: Tau = -0.494, p = 0.014 (SE_{Tau} = 0.282) P2: Tau = -0.628, p = 0.001 (SE_{Tau} = 0.246)

RT: Reaction Time / BC: Baseline Corrected / SE: Standard Error

Left frontal and prefrontal regions support globally coherent discourse in aphasia

Bobbi M. Aubrey^{1,2*}, and Brielle C. Stark^{1,2}

¹ Speech, Language and Hearing Sciences, Indiana University - Bloomington,
Bloomington, IN, USA

² Program in Neuroscience, Indiana University – Bloomington, Bloomington, IN, USA

*corresponding author: boaubre@iu.edu

Introduction

Language use requires the successful integration of many different cognitive processes, and many different areas of the brain have been implicated in cases of aphasia (Yourganov et al., 2015). Aphasia classically impacts linguistic function (semantics, phonology, syntax) and this is reflected in standard diagnostic tools that evaluate these isolated language abilities (Kertesz, 2007). Critically, some individuals with aphasia show macrostructural impairments, such as an inability to maintain topic, produce cohesive sentences and coherent narratives (Richardson, Dalton & Greenslade, 2024). Discourse analysis enables investigation of these discourse-level processes, which standard batteries neglect to assess. Identifying brain regions that contribute to macrostructural discourse processes will advance understanding of language and language impairments because producing coherent discourse requires the seamless integration of lexical access, syntactic planning, and cognitive control.

Methods

We analyzed a publicly-available dataset of adults with left-hemisphere stroke aphasia (Fridriksson, 2021). Each participant completed the Western Aphasia Battery–Revised (WAB-R; Kertesz, 2007) and produced a Cinderella retell after viewing the wordless picture book. Only individuals producing at least 20 unique words during Cinderella were carried forward into analyses (n=38).

Semantic “source similarity” was computed on the transcripts via latent semantic analysis (LSA) against the original Cinderella text using TAACO: Tool for the Automatic Analysis of Text Cohesion (Crossley et al., 2015). Semantic dissimilarity reveals impairments in global coherence—the high-level process that keeps the narrative’s “what-happened-and-why” intact—rather than a narrow lexical or syntactic deficits.

Spontaneous speech (from WAB-R), number of unique words from Cinderella retell, and LSA-based source similarity were related to binary lesion maps using parcel-based lesion-symptom mapping in NiiStat, restricting analyses to parcels damaged in ≥10 % of participants and correcting for multiple comparisons with 5000 permutations.

Results

Damage to left middle frontal gyrus (MFG) dorsal prefrontal cortex ($z=-3.24$) and inferior frontal gyrus (IFG) orbitalis ($z=-3.51$) were uniquely related to impairments of source similarity (reduced semantic overlap with known text) (Fig 1). Shared damage between source similarity and number of unique words was found in left MFG posterior, IFG opercularis and triangularis, and damage to dorsal white matter (anterior corona radiata;

external capsule). The spontaneous speech score was uniquely associated with damage to left superior longitudinal fasciculus ($z=-4.51$) and posterior insula ($z=-3.25$). See Table 1 for full results.

Conclusions

Individuals with low LSA source-similarity are those demonstrating a breakdown in macro-structural discourse planning, demonstrating impaired global coherence. These speakers are likely failing to select, organize, and integrate the story's key propositions into a coherent situation model, so the retell may drift off-topic, omit essential events, or substitute semantically vague vocabulary. A recent review indicated that language-related functions of the dorsolateral prefrontal cortex include pragmatic processing, discourse management, and error repair (Hertrich et al., 2021), and our findings support the role of the MFG dorsal prefrontal cortex in supporting language macrostructure.

References

- Crossley, S. A., Kyle, K., & McNamara, D. S. (2015). The tool for the automatic analysis of text cohesion (TAACO): Automatic assessment of local, global, and text cohesion. *Behavior Research Methods*, 48(4), 1227–1237.
<https://doi.org/10.3758/s13428-015-0651-7>
- Fridriksson, J., & Hillis, A. E. (2021). Current Approaches to the Treatment of Post-Stroke Aphasia. *Journal of Stroke*, 23(2), 183–201.
<https://doi.org/10.5853/jos.2020.05015>
- Hertrich, I., Dietrich, S., Blum, C., & Ackermann, H. (2021). The Role of the Dorsolateral Prefrontal Cortex for Speech and Language Processing. *Frontiers in human neuroscience*, 15, 645209. <https://doi.org/10.3389/fnhum.2021.645209>
- Kertesz, A. (2006). Western Aphasia Battery--Revised. *PsycTESTS Dataset*.
<https://doi.org/10.1037/t15168-000>
- Richardson, J. D., Dalton, S. G. H., & Greenslade, K. J. (2024). Assessing Impaired Macrostructures in Discourse Production of Persons with Aphasia. In *Spoken Discourse Impairments in the Neurogenic Populations: A State-of-the-Art, Contemporary Approach* (pp. 185-201). Cham: Springer International Publishing.
- Yourganov, G., Smith, K. G., Fridriksson, J., & Rorden, C. (2015). Predicting aphasia type from brain damage measured with structural MRI. *Cortex*, 73, 203–215.
<https://doi.org/10.1016/j.cortex.2015.09.005>

Acknowledgments

Thank you to the Center for the Study of Aphasia Recovery at the University of South Carolina (PI: Julius Fridriksson) for generous data sharing.

Figure 1. Lesions locations from all participants (top). Parcels where lesion significantly predicts source similarity score and not number of unique words (middle). Parcels where lesion load significantly predicts source similarity score and not the spontaneous speech sub-score from WAB-R (bottom).

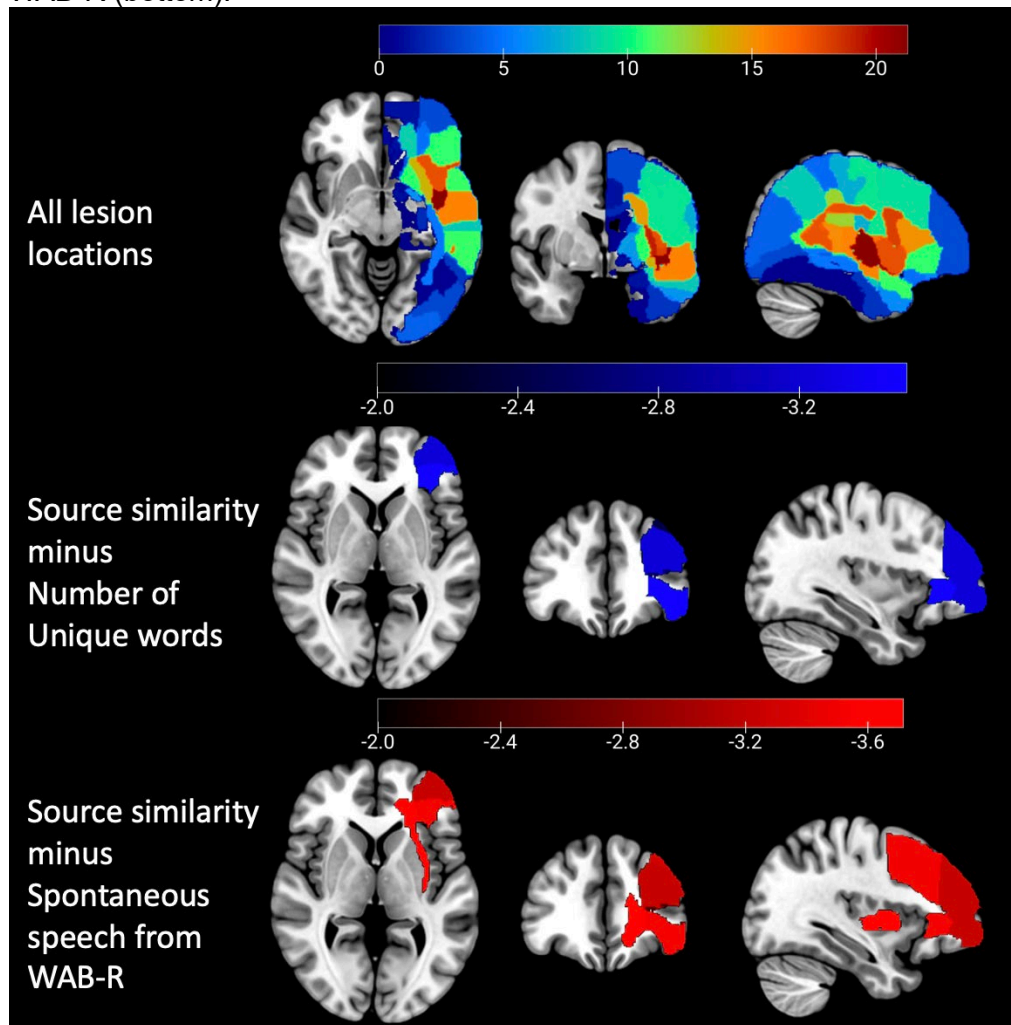


Table 1. Parcels where lesion load significantly predicts each discourse measure; z-scores corrected with 5000 permutations are shown.

Left Hemisphere Region (Johns Hopkins University Atlas)	Source Similarity (LSA)	Number of unique words	Spontaneous Speech subscore (WAB-R)
Middle frontal gyrus, posterior segment	-3.50	-3.38	—
Middle frontal gyrus, dorsal prefrontal cortex	-3.24	—	—
Inferior frontal gyrus, pars opercularis	-3.96	-3.61	-3.87
Inferior frontal gyrus, pars orbitalis	-3.51	—	—
Inferior frontal gyrus, pars triangularis	-3.76	-2.88	-3.30
Anterior corona radiata	-3.59	-2.87	—
External capsule	-3.72	-3.37	—
Precentral gyrus	—	-3.04	—
Putamen	—	-2.81	—
Superior corona radiata	—	-3.24	—
Inferior fronto-occipital fasciculus	—	-2.70	—
Superior longitudinal fasciculus	—	—	-4.51
Posterior insula	—	—	-3.25

Personalized Diagnosis and Therapy For Aphasic Patients using Large Language Models

Sreekar Baddepudi^{1*} and Swathi Kiran²

¹ Evergreen Valley High School, San Jose, California, USA

² Center for Brain Recovery, Boston University, Boston, Massachusetts, USA

*corresponding author, sreekar.baddepudi@gmail.com

Introduction

Aphasia is a neurological disorder caused by damage, often from a stroke, to specific language networks in the human brain, causing impaired communication abilities (Berthier, 2005). Often, the symptoms of aphasia can be managed with extensive speech-language therapy (Brady et al., 2016; Bryant et al., 2016); however, treatment is largely manual and time-intensive. This study investigates the potential of Large Language Models (LLMs) to enhance aphasia diagnosis and classification through the analysis of spontaneous speech samples and standardized test data.

Methods

61 transcriptions of spontaneous speech samples from the AphasiaBank database (MacWhinney et al., 2011) and detailed diagnostic test data from 6 patients at the Boston University Center for Brain Recovery were evaluated using Anthropic's Claude 3.5 Sonnet (Anthropic, 2023). AphasiaBank participants, aged 26–83, were selected to ensure a diverse distribution of aphasia types—Broca's (n = 21), Anomic (n = 17), Conduction (n = 9), Wernicke's (n = 5), Transcortical Motor (n = 3), and Not Aphasic (n = 6)—and all completed the standardized AphasiaBank discourse protocol (MacWhinney et al., 2011). Each transcript included spontaneous speech totaling approximately 30–45 minutes and an average of 220 participant speaking lines. In addition to these naturalistic samples, diagnostic test data from the Boston Naming Test (BNT; Kaplan et al., 1983), Psycholinguistic Assessments of Language Processing in Aphasia (PALPA; Kay et al., 1992), and Western Aphasia Battery (WAB; Kertesz, 2007) were collected for the BU CBR cohort. Claude 3.5 Sonnet was directed to analyze speech features and predict WAB scores and aphasia types using prompt engineering techniques. These included zero-shot prompting to extract and quantify linguistic impairments (Brown et al., 2020), chain-of-thought prompting to decompose WAB subscore estimation into intermediate reasoning steps (Brown et al., 2020), few-shot prompting with representative example patients to contextualize predictions (Howard & Gugger, 2020), and self-consistency prompting to synthesize multiple outputs into a final diagnosis (Brown et al., 2020). Prompts were tailored to mirror clinician diagnostic reasoning (Brookshire, 2015), enabling Claude to generate WAB-AQ estimates and aphasia classifications.

Results

Analysis of AphasiaBank samples achieved 85.25% accuracy in aphasia classification and demonstrated strong correlation with WAB scores ($R^2 = 0.91$, RMSE = 5.42). The model showed highest accuracy in mild to moderate cases (WAB-AQ > 55) with reduced

performance in severe cases. Analysis of diagnostic test data achieved 100% accuracy in both severity prediction and aphasia classification within the constraints of a small sample size ($R^2 = 1.00$, RMSE = 0.00) (Figure 1). The model's perfect performance in the diagnostic test group ($N = 6$) was due to explicit numerical scores from the WAB, BNT, and PALPA. Unlike spontaneous speech, these scores are directly mappable to standardized criteria for both aphasia severity and subtype. Claude's high arithmetic precision enabled precise WAB-AQ calculation. Additionally, the use of a decision tree framework for aphasia classification based on these numeric subscores dramatically reduced ambiguity.

Conclusions

The results suggest that LLMs can serve as valuable supportive tools for aphasia diagnosis, particularly in analyzing spontaneous speech patterns. Future research should focus on larger-scale validation studies, refinement of assessment techniques for severe cases, and investigation into the best modalities of data to be provided to the model.

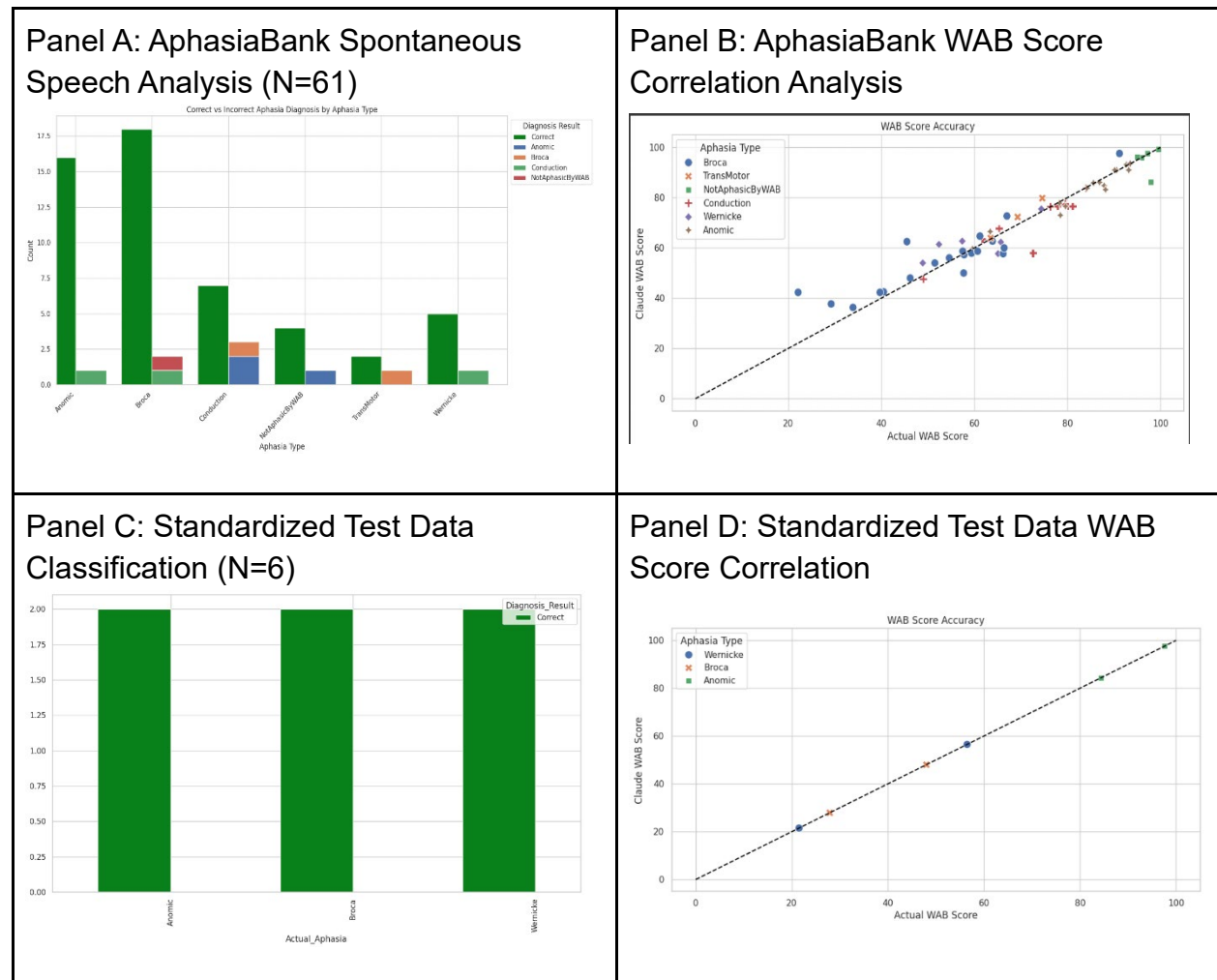
References

- Anthropic. (2023). Claude API documentation. Retrieved from <https://www.anthropic.com>
- Berthier, M. L. (2005). Poststroke aphasia: Epidemiology, pathophysiology, and treatment. *Cerebrovascular Diseases*, 20(Suppl. 2), 1–17.
- Brady, M. C., Kelly, H., Godwin, J., & Enderby, P. (2016). Speech and language therapy for aphasia following stroke. *Cochrane Database of Systematic Reviews*, 6, CD000425. <https://doi.org/10.1002/14651858.CD000425.pub4>
- Bryant, L., Ferguson, A., & Spencer, E. (2016). Linguistic and cognitive rehabilitation for aphasia: Evaluating the evidence. *Neuropsychological Rehabilitation*, 26(5–6), 751–779.
- Brookshire, R. H. (2015). *Introduction to neurogenic communication disorders* (8th ed.). Mosby.
- Brown, T. B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., ... & Amodei, D. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems*, 33, 1877–1901.
- Howard, J., & Gugger, S. (2020). Fastai: A layered API for deep learning. *Information*, 11(2), 108.
- Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *Boston Naming Test*. Philadelphia: Lea & Febiger.
- Kay, J., Lesser, R., & Coltheart, M. (1992). *Psycholinguistic Assessments of Language Processing in Aphasia (PALPA)*. Psychology Press.
- Kertesz, A. (2006). *Western Aphasia Battery-Revised (WAB-R)*. Pearson.
- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for studying discourse. *Aphasiology*, 25(11), 1286–1307.

Acknowledgments

Thank you to Dr. Swathi Kiran and the BU CBR Team for offering valuable feedback and insights to better the effectiveness of the tool. Special thanks to Dr. Kiran for taking me into the Center and aiding along the process.

Figure 1. Claude 3.5 Sonnet demonstrates differential performance across data modalities in aphasia diagnosis. Panels A-B show results from AphasiaBank spontaneous speech analysis: 85.25% classification accuracy with strongest performance for Anomic aphasia, and good WAB score correlation ($R^2 = 0.91$, RMSE = 5.42). Broca's aphasia showed the largest number of misclassifications, including instances incorrectly classified as Anomic, Conduction, and Not Aphasic/Broca categories. Panels C-D show perfect performance on standardized test data from BU CBR patients: 100% classification accuracy and perfect WAB score correlation ($R^2 = 1.00$, RMSE = 0.00). Superior performance with standardized tests reflects precise numerical score calculation versus complex linguistic analysis required for spontaneous speech.



Connected speech features in post-stroke agrammatic aphasia: Evidence from Bengali

Sayantani Banerjee^{1*}, Arpita Bose², Niladri Sekhar Dash³ and Abhijeet Patra^{2,4}

¹ Department of Computer Sciences and Engineering, Indian Institute of Technology, Madras, India.

²School of Psychology and Clinical Language Sciences, University of Reading, UK. ³Linguistic Research Unit, Indian Statistical Institute, Kolkata, India.

^{2,4}Manchester Metropolitan University, UK.

*corresponding author, banerjeesayantani01@gmail.com

Introduction

This research reports the first comprehensive characterization of agrammatism in Bengali speakers with non-fluent aphasia. It examines whether the core linguistic symptom triad identified in English agrammatism -- fragmented utterances, deficits in functional morphology and scarcity of verbs (Bastiaanse & Thompson, 2012; Faroqi-Shah, 2023) -- replicates in a typologically different language from English. Bengali (*Bangla*) is a pro-drop Indo-Aryan language with flexible word order and rich inflectional morphology. Bengali exhibits rich case systems with non-nominative subjects, reduplication, complex predicates, postpositions and rich verb agreement. We predict that these linguistic characteristics would manifest distinctively speakers of Bengali.

Methods

Participants

Three individuals with People with post-stroke Aphasia, PWA (PWA1, PWA2, PWA3) with moderate Broca's aphasia and a group of eight age-, education- and sex-matched controls participated in this study. The primary inclusion criteria was aphasia following a left CVA with clinically presenting "agrammatic by clinical standard" (Menn & Obler, 1990).

Task, transcription and analysis

Narrative samples were elicited for all participants using the wordless picture book, "Frog, where are you?" (Mayer, 1969). Samples were transcribed, segmented, and analyzed using and augmenting the Quantitative Production Analysis (QPA; Berndt et al., 2000; Bose et al., 2022). We measured speech rate, syntactic structure, lexical distribution and morphological accuracy. Single-subject statistical comparisons were made between each PWA and controls (Crawford et al., 2010).

Results

Table 1 presents the participant details and the results of the connected speech analyses of the Frog Story. Grey shading indicates values significantly different from the controls.

Conclusions

Our results show that Bengali speakers with post-stroke agrammatic aphasia exhibit both similarities (speech rate, syntactic characteristics and lexical distribution) and differences (in inflectional properties) from English agrammatic features. It appears then that amongst the core triad of symptoms suggested in the literature, Bengali agrammatic does show difficulty in “fragmented utterances and sentences”. There remain distinct differences in functional morphology and verbs. Although difficulty with verb inflection is a salient feature in English, this was not the case for the Bengali speakers. None of them showed any error in verb inflections, and all verb tokens were produced correctly. However, they did show a limited variety of inflectional paradigms. The findings highlight the importance of documenting cross-linguistic variation of agrammatic symptoms for a deeper understanding of the condition and for developing language-specific markers for better assessments and interventions.

References

- Bastiaanse & Thompson (Eds.). (2012). *Perspectives on agrammatism*. Hove: Psychology Press.
- Berndt, R. S., Wayland, S., et al. (2000). *Quantitative Production Analysis: A Training Manual for the Analysis of Aphasic Sentence Production*. Psychology Press.
- Crawford, J. R., Garthwaite, P. H., and Porter, S. (2010). Point and interval estimates of effect sizes for the case-controls design in neuropsychology: rationale, methods, implementations, and proposed reporting standards. *Cogn. Neuropsychol.* 27, 245–260.
- Faroqi-Shah, Y. (2023). A reconceptualization of sentence production in post-stroke agrammatic aphasia: the synergistic processing bottleneck model. *Frontiers in Language Sciences*, 2, 1118739.
- Mayer M. (1969). *Frog, Where are You?* New York, NY: Penguin Books.
- Menn, L., Obler, L. K., & Miceli, G. (Eds.). (1990). *Agrammatic aphasia: A cross-language narrative sourcebook* (Vol. 2). John Benjamins Publishing.

Acknowledgments

We thank our participants for their time and enthusiasm for our research.

Table 1 shows all three PWAs evidenced reduced speech rate and syntactically impoverished productions. PWAs showed shorter (shorter MLU) and structurally simpler sentences, smaller proportion of well-formed sentences (PWA1, PWA2), implying large number of ungrammatical constructions as well as lower embedding index. Lexically, PWAs showed preponderance of content words, with higher proportion of nouns than verbs (only for PWA1 and PWA3), and limitation with closed class words (only for PWA1 and PWA3).

Demographics and aphasia characteristics				
Variables	PWA1	PWA2	PWA3	
Age/Sex	50/Male	58/Female	50/Male	
Years of education	18	12	17	
Highest degree	Postgraduate	High school	Graduate	
Time post onset (months)	17	45	19	
Site of lesion/Medical history	Left cerebral haemorrhage	Left MCA bifurcation aneurysm	Left acute large MCA infarct	
Pre-stroke occupation	Accountant	Homemaker	Sales and Marketing	
Aphasia type (WAB)	Broca's	Broca's	Broca's	
Aphasia Quotient	68.8	74.2	64.0	
Linguistic domains and variables				
Speech rate				Controls (Mean/SD)
Words per minute	15.59	22.68	35.6	135.92 (31.89)
Structural and syntactic measures				
Mean sentence length	4.35	4.55	3.50	7.67 (1.0)
Proportion of well-formed sentences	0.75	0.89	0.37	0.97 (0.06)
Embedding index	0.00	0.14	0.00	0.50 (0.18)
Lexical measures				
Proportion of nouns (N/all NW)	0.50	0.36	0.68	0.47 (0.03)
Proportion of verbs (V/all NW)	0.23	0.32	0.29	0.45 (0.04)
Proportion of closed class words (CC/all NW)	0.14	0.19	0.07	0.24 (0.04)
Proportion of pronouns (P/all NW)	0.00	0.00	0.00	0.24 (0.07)
Morphological and inflectional measures				
Noun Inflection index	0.80	0.72	0.64	1 (0.02)
Verb Inflection Index	1.00	1.00	1.00	1 (0.01)

[WAB: Western Aphasia Battery, N: Noun, NW: Number of Narrative words, V: Verb, CC: Closed Class words, P: Pronouns] No pronouns were produced by any PWA. These participants showed intact verb inflections (although limited variety of tokens) but impaired noun inflections.

The Contribution of Bilingualism to Cognitive Reserve in Alzheimer's Disease: Evidence from Neuropsychological Functioning and Biomarkers

Wenfu Bao¹, Stephanie M. Grasso¹, Marco Calabria², Isabel Sala^{3,4}, M. Belén Sánchez-Saudinós^{3,4}, Lúdia Vaqué-Alcázar^{3,5}, Alexandre Bejanin^{3,4}, María Carmona-Iragui^{3,4,6}, Isabel Barroeta^{3,4,6}, Ignacio Illán-Gala^{3,4}, Juan Fortea^{3,4,6}, Olivia Belbin^{3,4}, Daniel Alcolea^{3,4}, Alberto Lleó^{3,4}, Miguel Ángel Santos-Santos^{3,4*}

¹ Department of Speech, Language, and Hearing Sciences, The University of Texas at Austin, Austin, USA

² NeuroADaS Lab, Universitat Oberta de Catalunya, Barcelona, Spain

³ Sant Pau Memory Unit, Department of Neurology, IR SANT PAU, Hospital de la Santa Creu i Sant Pau, Universitat Autònoma de Barcelona, Barcelona, Spain

⁴ Network Center for Biomedical Research in Neurodegenerative Diseases (CIBERNED), National Institute of Health Carlos III, Madrid, Spain

⁵ Department of Medicine, Faculty of Medicine and Health Sciences, Institute of Neurosciences, University of Barcelona, Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain

⁶ Barcelona Down Medical Center, Fundació Catalana Síndrome de Down, Barcelona, Spain

***corresponding author, msantoss@santpau.cat**

Introduction

Bilingualism has been suggested to contribute to cognitive reserve, with better neuropsychological outcomes and delayed dementia onset up to five years (e.g., Celik et al., 2022; Van den Noort et al., 2019). The underlying mechanisms driving such protective effects, however, are rarely explored. Approaching this issue from a biological perspective is critical to understanding resilience (i.e., better-than-expected cognition given pathology, or higher-than-expected pathology given cognition) vs. resistance (i.e., lower-than-expected pathology; Arenaza-Urquijo & Vemuri, 2018; Montine et al., 2019) to Alzheimer's disease (AD). Yet, literature examining biological bases of bilingualism's effects in dementia is nearly nonexistent. This study investigated the contribution of bilingualism and its potential interaction with sex or education to cognitive reserve in AD participants, reflected by neuropsychological functioning and molecular biomarkers of brain health.

Methods

We included 567 Spanish-Catalan bilingual participants with cerebrospinal fluid (CSF) biomarker-confirmed AD (i.e., amyloid-beta and tau positive) from the Hospital Sant Pau. Following frameworks presented in Arenaza-Urquijo and Vemuri (2018) and Montine et al. (2019), since participants were at the same AD biological stage (i.e., A+T+; Jack et al., 2018), higher-than-expected cognition was considered evidence of resilience and lower-than-expected pathology of resistance. Participants received neuropsychological evaluations, CSF and blood biomarker testing, and language-use assessments. Consistent with prior literature (Calabria et al., 2020), participants were categorized into

active bilinguals (frequent Catalan and Spanish use) and passive bilinguals (Spanish speakers with Catalan exposure). Generalized linear models were used to determine effects of bilingualism and its interaction with sex or education on (i) neuropsychological functioning, (ii) CSF and plasma biomarkers reflecting amyloid-beta ($A\beta$ -42, $A\beta$ -42/40 ratio) and tau accumulation (phospho-tau, total-tau (CSF only)), neurodegeneration (neurofilament light), and neuroinflammation (glial fibrillary acidic protein or GFAP, Chitinase-3-like protein 1 or YKL-40 (CSF only)).

Results

The two groups were comparable in age and sex, but active bilinguals had greater years of education (see Table 1). Adjusting for the aforementioned variables, neuropsychological data suggested better cognition in active bilinguals across domains: attention and executive function (i.e., Trail Making Tests, see Figure 1A for Test A), language (i.e., phonetic fluency, Boston Naming Test), and visuospatial abilities (i.e., CERAD figure copy), demonstrating resilience. Regarding biomarker data, when accounting for the interaction with sex or education, active bilinguals showed a more favorable profile—indicating less pathology and thus resistance—reflected by a higher CSF $A\beta$ -42/40 ratio in male participants (Figure 1B), lower CSF YKL-40 in female participants, and lower CSF GFAP in participants with higher education. A less favorable profile—suggesting greater pathology and thus resilience—was also observed in active bilinguals, characterized by lower CSF $A\beta$ -42 in female participants only.

Conclusions

Active bilingualism contributes to cognitive reserve in biomarker-confirmed AD participants. This contribution is possibly made through both resilience and resistance to AD pathology, evidenced by cognition and pathophysiologic burden. Further, our findings suggest that such protective effects at the biological level differ as a function of other factors impacting cognitive reserve (i.e., sex, education). Future mediation analyses will allow us to determine if biomarkers mediate the relation between bilingualism and cognition.

References

- Arenaza-Urquijo, E. M., & Vemuri, P. (2018). Resistance vs resilience to Alzheimer disease: Clarifying terminology for preclinical studies. *Neurology*, 90(15), 695–703.
- Calabria, M., Hernández, M., Cattaneo, G., Suades, A., Serra, M., Juncadella, M., Reñé, R., Sala, I., Lleó, A., Ortiz-Gil, J., Ugas, L., Ávila, A., Ruiz, I. G., Ávila, C., & Costa, A. (2020). Active bilingualism delays the onset of mild cognitive impairment. *Neuropsychologia*, 146, 107528.
- Celik, S., Kokje, E., Meyer, P., Frölich, L., & Teichmann, B. (2020). Does bilingualism influence neuropsychological test performance in older adults? A systematic review. *Applied Neuropsychology: Adult*, 29(4), 855–873.
- Jack, C. R., Bennett, D. A., Blennow, K., Carrillo, M. C., Dunn, B., Haeberlein, S. B., Holtzman, D. M., Jagust, W., Jessen, F., Karlawish, J., Liu, E., Molinuevo, J. L., Montine, T., Phelps, C., Rankin, K. P., Rowe, C. C., Scheltens, P., Siemers, E., Snyder, H. M., Sperling, R., ... Contributors (2018). NIA-AA Research Framework:

Toward a biological definition of Alzheimer's disease. *Alzheimer's & Dementia*, 14(4), 535–562.

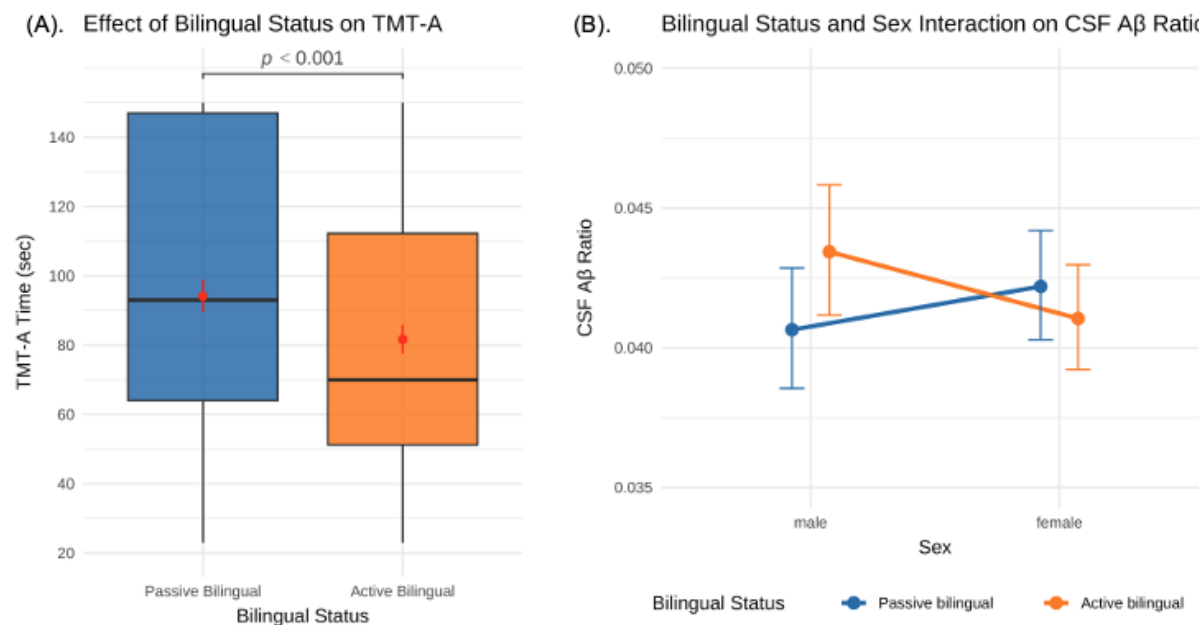
Montine, T. J., Cholerton, B. A., Corrada, M. M., Edland, S. D., Flanagan, M. E., Hemmy, L. S., Kawas, C. H., & White, L. R. (2019). Concepts for brain aging: resistance, resilience, reserve, and compensation. *Alzheimer's Research & Therapy*, 11(1), 22.

Van den Noort, M., Vermeire, K., Bosch, P., Staudte, H., Krajenbrink, T., Jaswetz, L., Struys, E., Yeo, S., Barisch, P., Perriard, B., Lee, S.-H., & Lim, S. (2019). A systematic review on the possible relationship between bilingualism, cognitive decline, and the onset of dementia. *Behavioral Sciences*, 9(7), 81.

Acknowledgments

We acknowledge the funding from the Alzheimer's Association Clinician Scientist Fellowship awarded to M.A.S.-S., and R01AG080470 from the National Institute on Aging of the National Institutes of Health awarded to S.G. and M.A.S.-S.

Figure 1. Example associations between bilingual status and neuropsychological functioning and biomarker variables: TMT-A and CSF A β -42/40 ratio



Note. In panel (A), the red dots and bands represent predicted means and 95% confidence intervals computed from the optimal model, respectively. Active bilinguals had a significantly lower value ($p < 0.001$; indicating better performance) than passive bilinguals. In panel (B), within male participants, active bilinguals had a significantly higher CSF A β -42/40 ratio ($p = 0.022$; indicating less pathology) than passive bilinguals.

Abbreviations: TMT-A: Trail Making Test-A. CSF: cerebrospinal fluid. A β : Amyloid-beta.

Table 1. Descriptive statistics of demographic, neuropsychological, and biomarker data across passive and active bilingual groups

Variable	Passive bilingual (N = 287)	Active bilingual (N = 280)	N
Age (in years)	75.5 (4.48)	76.0 (4.69)	567
Sex			566 [#]
Male	107 (37.3%)	113 (40.5%)	
Female	180 (62.7%)	166 (59.5%)	
Education (in years)	9.71 (5.00)	11.2 (4.45)	549
<i>Neuropsychological functioning</i>			
MMSE	24.1 (3.65)	24.9 (3.32)	492
Verbal Memory Immediate Free Recall	6.56 (6.31)	6.29 (6.10)	530
Verbal Memory Delayed Free Recall	1.86 (2.69)	1.58 (2.49)	530
Visual Memory Free Recall	2.16 (2.85)	2.04 (2.76)	464
CERAD Figure Copy	8.31 (2.26)	9.29 (1.79)	463
Boston Naming Test (in percentage)	66.4 (15.7)	70.1 (15.5)	480
Phonetic Fluency	8.11 (4.24)	9.19 (4.54)	537
Semantic Fluency	11.2 (4.41)	11.8 (4.95)	537
Digit Span Backwards	3.18 (1.00)	3.45 (0.99)	535
Trail Making Test-A (in seconds)	98.5 (39.9)	81.9 (37.7)	531
Trail Making Test-B (in seconds)	267 (64.5)	243 (75.7)	531
<i>CSF and plasma biomarker</i>			
CSF A β -42 (pg/mL)	580 (184)	562 (163)	528
CSF A β -42/40 Ratio	0.0443 (0.0087)	0.0447 (0.0084)	528
Plasma A β -42/40 Ratio	0.098 (0.004)	0.100 (0.008)	32
CSF pTau (pg/mL)	118 (61.6)	119 (58.6)	528
Plasma pTau 181 (pg/mL)	21.0 (10.2)	20.4 (8.49)	85
Plasma pTau 217 (pg/mL)	1.24 (0.56)	1.47 (0.76)	69
CSF tTau (pg/mL)	726 (332)	726 (331)	527
CSF NfL (pg/mL)	1095 (678)	1171 (783)	128
Plasma NfL (pg/mL)	19.5 (12.5)	18.2 (8.86)	173
CSF GFAP (pg/mL)	10779 (6573)	9693 (6611)	59
Plasma GFAP (pg/mL)	228 (79.3)	282 (133)	69
CSF YKL-40 (pg/mL)	308 (67.9)	305 (108)	131

Note. Variables indicating significant group comparisons (derived from ANOVA) are in bold. [#]

One active bilingual participant did not report on sex.

Abbreviations: MMSE: Mini-Mental State Examination. CERAD: Consortium to Establish a Registry for Alzheimer's Disease. CSF: cerebrospinal fluid. A β : Amyloid-beta. pTau: phosphorylated tau. tTau: total tau. NfL: neurofilament light. GFAP: glial fibrillary acidic protein. YKL-40: Chitinase-3-like protein 1 (CHI3L1, also known as YKL-40).

Conversation-Based Therapy for Aphasia: Neural Reorganization and Behavioral Outcomes from a Storytelling Intervention

Biraj Bhattarai^{1*} and Bijoyaa Mohapatra¹

¹ Department of Communication Sciences and Disorders, Louisiana State University, Baton Rouge, Louisiana, USA

*corresponding author, bbhatt6@lsu.edu

Introduction

Traditional aphasia therapies primarily focus on specific linguistic deficits, with the assumption that gains will generalize to functional communication. Although effective in improving communication outcomes (Joma, 2018; Rumpca, 2017; Savage et al., 2014), these approaches often neglect underlying neural mechanisms. This study investigates the impact of intensive conversation-based training on cortical reorganization in individuals with aphasia, as measured by functional near-infrared spectroscopy (fNIRS).

Methods

A single-subject research design was used to examine effects of the TimeSlips™ creative storytelling program (Basting, 2003) on brain function in a person with aphasia. The participant was a 66-year-old female with mild Broca's aphasia (WAB-R AQ = 88), ten years post-stroke, who had not received speech-language therapy for over a year. The six-week intervention included ten individual sessions (1.5 hours/day, three days/week), delivered by an ASHA-certified, TimeSlips™-trained speech-language pathologist. Each session involved presenting a visual prompt from the TimeSlips™ database, encouraging imaginative storytelling through guided, open-ended questions (e.g., "What do you see/hear/smell in this picture?"; Mohapatra & Mohan, 2023).

Behavioral outcomes were assessed across language, cognitive-linguistic skills, functional communication, communicative effectiveness, and quality of life. Discourse production was evaluated pre- and post-intervention using a story retelling task ("The Bear and the Fly") and a procedural discourse task (e.g., making a peanut-butter-jelly sandwich).

Resting-state neuroimaging was conducted pre- and post-intervention using a 27-channel fNIRS system (Artinis Medical Systems). Hemodynamic responses (HbO and HbR) were recorded from bilateral perisylvian regions involved in discourse processing, including Broca's area, the superior dorsolateral prefrontal cortex (dlPFC), and the supramarginal gyrus—associated with syntactic planning, executive function, and semantic integration (Braun, 2023; Kiran et al., 2019). Channels were grouped into four ROIs: right hemisphere (Group 1: dlPFC and homologous Broca's area; Group 2: supramarginal gyrus) and left hemisphere (Group 3: supramarginal gyrus; Group 4: dlPFC and Broca's area).

Results

Behaviorally, correct information units increased from 87.3% to 90.45% on a procedural discourse task and from 86.27% to 87.01% on story retelling task, indicating improved informativeness in semi-spontaneous speech and reflecting positive training-related

changes in discourse-level language in PWA. Hemodynamically, average HbO levels increased and HbR levels decreased across all four optode groups following the intervention, though these changes were not statistically significant ($p > 0.05$; see Table 1). During the pre-therapy phase, activation was predominantly right-lateralized, particularly in the right supramarginal gyrus (figure 1A, right lateral view). In contrast, at post- storytelling intervention, greater activation was observed in the right supramarginal region and Broca's area (figure 1B, right lateral view, indicated by warmer colors), along with increased activation in the left dIPFC (figure 1B, anterior view), likely reflect therapy-induced recruitment of neural substrates underlying syntactic processing, executive control, and semantic integration.

Conclusion

This single-subject study demonstrates that a creative storytelling intervention can enhance neural reorganization linked to language recovery in aphasia. Post-training fNIRS data revealed increased bilateral activation—particularly in the right supramarginal gyrus, homologous Broca's area, and left dIPFC—alongside improved discourse informativeness, underscoring the potential of narrative-based therapies to support both neural and functional communication outcomes.

References:

- Basting, A. D. (2003). Exploring the creative potential of people with Alzheimer's disease and related dementia: Dare to imagine. *Mental wellness in aging: Strengths-based approaches*, 353-367.
- Braun, E. J. (2023). Behavioral and Neural Evaluation of Discourse Production in Neurotypical Individuals and Individuals with Aphasia. *ProQuest LLC*.
- Joma, A. (2018). Aphasia Couples Therapy: A Case Study of Conversational Coaching for a Man with Conduction Aphasia. <https://scholarlycommons.pacific.edu/>
- Mohapatra, B., & Mohan, R. (2023). Preliminary Findings from a Collaborative Storytelling Program on Life Participation and Communication among Persons with Aphasia. *Aphasiology*, 37(11), 1818–1838. <https://doi.org/10.1080/02687038.2022.2127086>
- Rumpca, A. M. (2017). Conversation Training in Aphasia: A Single Case Study. https://repository.stcloudstate.edu/csd_etds/4
- Savage, M. C., Donovan, N. J., & Hoffman, P. R. (2014). Preliminary results from conversation therapy in two cases of Aphasia. *Aphasiology*, 28(5), 616–636. <https://doi.org/10.1080/02687038.2013.843153>

Acknowledgments

Authors would like to thank the participant for their time and participation in this study.

Figure 1. Hemodynamic Activation Patterns in Cortical Regions Observed During (A) Pre-therapy and (B) Post-therapy

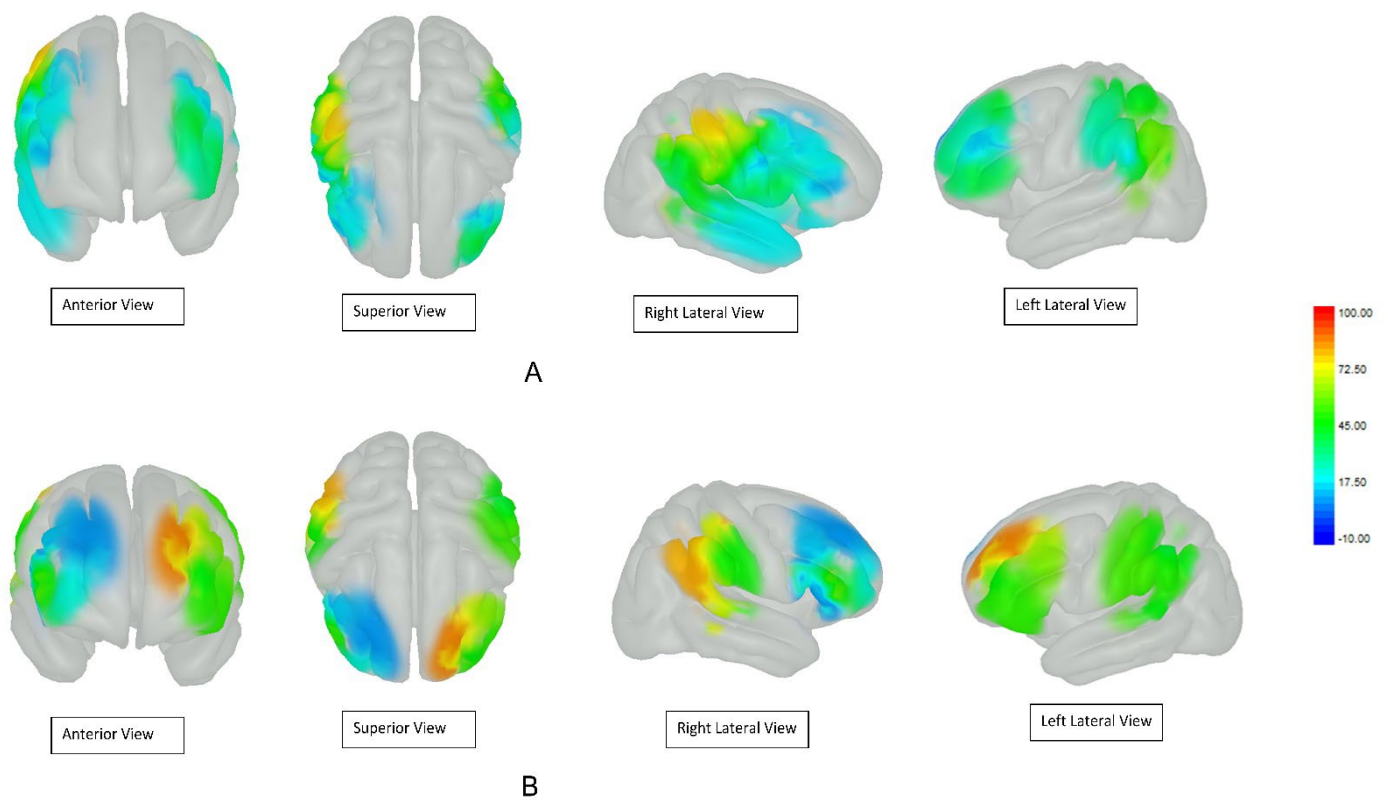


Table 1. Mean Concentrations of Oxygenated and Deoxygenated Hemoglobin Recorded Across Four Optode Groups During Pre- and Post-Storytelling Intervention

Optode Groups	Pre-therapy		Post-therapy	
	HbO	Hhb	HbO	Hhb
1	-1.39	-0.21	-0.42	-0.66
2	-1.13	-0.36	0.34	0.035
3	-1.20	-0.34	-1.28	-0.81
4	-1.20	-0.65	-0.12	-1.32

Note. HbO: Oxyhemoglobin; Hhb: Deoxyhemoglobin. HbO and Hhb level measured in $\mu\text{mol/l}$.

Test-retest reliability of TRF-derived measures of cortical tracking of speech in individuals with aphasia

Kathleen E. Bradbury-John^{1*}, G. Nike Gnanateja², and Heather R. Dial¹

¹ Department of Communication Sciences and Disorders, University of Houston, Houston, TX, USA

² Department of Communication Sciences and Disorders, University of Wisconsin-Madison, Madison, WI, USA

*corresponding author, kebradbu@cougarnet.uh.edu

Introduction

Cortical tracking, the alignment of neural oscillations to quasi-rhythmic fluctuations in speech, is increasingly being used to investigate the cognitive and neural bases of receptive speech processing. Specifically, the delta (1-4 Hz) and theta (4-8 Hz) bands have been proposed to process features of phrases and syllables respectively (Gnanateja et al., 2022). Differences in cortical tracking have been observed in primary progressive (Dial et al., 2021) and stroke-induced (Kries et al., 2024) aphasia compared to healthy controls, but the extent to which these differences are meaningful depends upon the reliability of the measures. Research on temporal response function (TRF) modeling, which quantifies how well the brain tracks specified features, has shown moderate to good reliability (ICC ~ 0.5-0.8) in tracking naturalistic speech in healthy controls (Panella et al., 2024; Dial & Gnanateja, under review); however, no study has investigated reliability in clinical populations. The current study reports test-retest reliability of TRF modeling in individuals with stroke-induced aphasia.

Methods

Ten individuals with stroke-induced aphasia listened to 30 one-minute segments of an audiobook at two timepoints while EEG data were recorded. Cortical tracking of the broadband and multiband speech envelopes and their derivatives was estimated for delta and theta bands using the mTRF toolbox (Crosse et al., 2016). Prediction accuracy of the TRF model was calculated as Pearson's correlation between the TRF-predicted and observed EEGs. Prediction accuracy ICCs and TRF time-course ICCs were calculated between sessions, separately for each stimulus feature and frequency band. ICC values of <0.5 indicated poor reliability, 0.5-0.75 indicated moderate reliability, 0.75-0.9 indicated good reliability, and 0.9-1.0 indicated excellent reliability (Koo & Li, 2016).

Results

Demographic and timing data is reported in Table 1. Time-course ICCs showed the highest reliability (ICC ~0.6-0.8) from 100-300ms across stimulus features, with slightly higher ICCs observed for the theta band (Figure 1). ICCs of prediction accuracies across channels are reported in Figure 1, with greater reliability in the theta band compared to the delta band, across stimulus features. Additional analyses sought to determine how much data is needed to reach good reliability. ICCs of prediction accuracies in the theta band reached good reliability (~0.8) using 15 segments of data for the broadband and

broadband derivative envelopes and 25 segments of data for the multiband and multiband derivative. In comparison, the delta band never reached ICCs above 0.7 for any stimulus feature.

Conclusions

Data collection is ongoing, but we observed moderate to good reliability of the TRF time course in delta and theta bands. Reliability for prediction accuracies was good in the theta band and moderate in the delta band, with the highest reliability observed in right frontal and parietal electrodes. While the reliability reported here is lower than other measures designed to reduce testing burden (i.e. the Quick Aphasia Battery with ICCs >0.9; Wilson et al., 2018), TRF modeling has additional benefits, including the ability to investigate neurophysiological changes in different aspects of speech comprehension. To ensure reliability of these methods, developments to further enhance reliability are underway.

References

- Crosse, M. J., Di Liberto, G. M., Bednar, A., & Lalor, E. C. (2016). The Multivariate Temporal Response Function (mTRF) Toolbox: A MATLAB Toolbox for Relating Neural Signals to Continuous Stimuli. *Frontiers in Human Neuroscience*, 10, 604. <https://doi.org/10.3389/fnhum.2016.00604>
- Dial, H. R., Gnanateja, G. N., Tessmer, R. S., Gorno-Tempini, M. L., Chandrasekaran, B., & Henry, M. L. (2021). Cortical Tracking of the Speech Envelope in Logopenic Variant Primary Progressive Aphasia. *Frontiers in Human Neuroscience*, 14, 597694. <https://doi.org/10.3389/fnhum.2020.597694>
- Gnanateja, G. N., Devaraju, D. S., Heyne, M., Quique, Y. M., Sitek, K. R., Tardif, M. C., Tessmer, R., & Dial, H. R. (2022). On the Role of Neural Oscillations Across Timescales in Speech and Music Processing. *Frontiers in Computational Neuroscience*, 16, 872093. <https://doi.org/10.3389/fncom.2022.872093>
- Koo, T. K., & Li, M. Y. (2016). A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *Journal of Chiropractic Medicine*, 15(2), 155–163. <https://doi.org/10.1016/j.jcm.2016.02.012>
- Kries, J., De Clercq, P., Gillis, M., Vanthornhout, J., Lemmens, R., Francart, T., & Vandermosten, M. (2024). Exploring neural tracking of acoustic and linguistic speech representations in individuals with post-stroke aphasia. *Human Brain Mapping*, 45(8), e26676. <https://doi.org/10.1002/hbm.26676>
- Panella, R. A., Copelli, F., & Herrmann, B. (2024). Reliability and generalizability of neural speech tracking in younger and older adults. *Neurobiology of Aging*, 134, 165–180. <https://doi.org/10.1016/j.neurobiolaging.2023.11.007>
- Wilson, S. M., Eriksson, D. K., Schneck, S. M., & Lucanie, J. M. (2018). A quick aphasia battery for efficient, reliable, and multidimensional assessment of language function. *PloS One*, 13(2), e0192773.

Acknowledgments

We greatly appreciate all of the participants and their loved ones for their involvement and participation in this study! We are also thankful for all the members of the UH SLAB Lab who have helped with data collection and preprocessing. This work was supported by NIH/NIDCD R21DC021497 (awarded to Heather Dial).

Figure 1. Topoplot ICCs and time-course ICCs for different frequency bands and stimulus features.

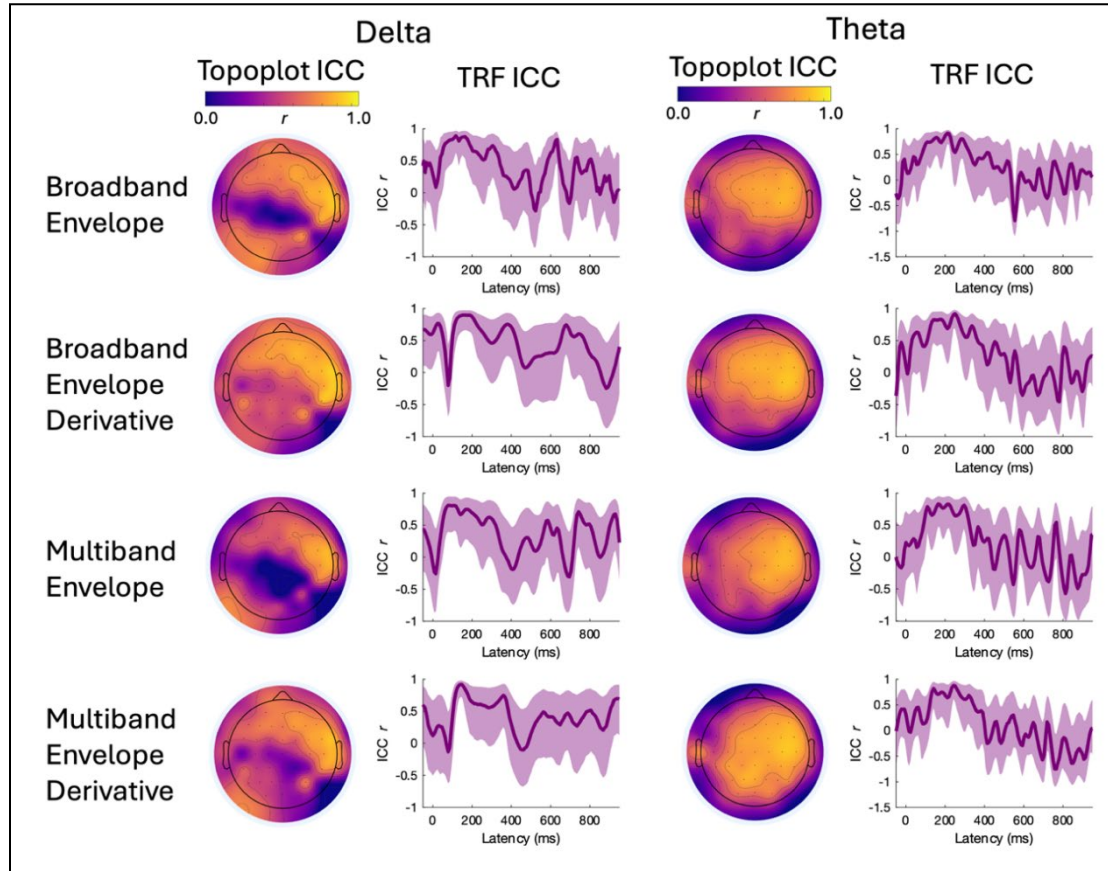


Table 1. Demographic and Session Timing Data

Group	N	Race	Gender		Age (years)	Education (years)	Time Between Sessions (days)
			Women	Men	M (SD)	M (SD)	M (SD)

Aphasia	10	6 Black, 3 White, 1 Multiracial *	4	6	55.80 (10.16)	14.22 (2.11)**	13.7 (6.31)

Note. N = Number of Participants; M = Mean; SD = Standard Deviation

*All Non-Hispanic/Latino; **1 participant missing education

Exploring Brain Electric Fields in Primary Progressive Aphasia Therapy

Christie Carroll-Duhigg^{1*}, Julian David¹, Evon Youkhana¹, Anum Amin¹, Joel Upston¹, Maya Henry², Davin Quinn¹, Rick Arenas¹, Jessica D. Richardson¹

¹ University of New Mexico, Albuquerque, New Mexico, USA

² University of Texas – Austin, Austin, TX, USA

***corresponding author, ccduhigg@unm.edu**

Introduction

Primary progressive aphasia (PPA) is a dementia syndrome characterized by the gradual decline of speech and language due to neurodegeneration, most commonly associated with Alzheimer's disease (AD) or frontotemporal lobar degeneration (FTLD). It primarily affects left hemisphere language-related areas, with symptom progression and presentation varying significantly across individuals due to differences in the site and extent of atrophy, underlying pathology, and compensatory mechanisms - highlighting the need for personalized intervention strategies.

Transcranial direct current stimulation (tDCS) has shown potential in alleviating symptoms in people with PPA (PWPPA). tDCS effectiveness depends on the electric field (E-field) generated in the brain, which is influenced by electrode placement, individual neuroanatomy, and tissue conductivity. Computational modeling enables simulation of the E-field within patient-specific 3D brain models, allowing prediction of current distribution and optimization of stimulation parameters to effectively target regions of interest (ROIs) while minimizing off-target effects. However, much of the tDCS-PPA literature lacks consistent parameter reporting and individualized modeling. Many studies rely on montage designs developed for stroke or healthy controls, which may not translate effectively to the unique neuroanatomy of PWPPA. Here we characterize the current state of the field by conducting a scoping review of published tDCS studies in PPA and then modeling the E-field distributions of commonly used montages using individualized MRI-based head models from PWPPA and controls.

Methods

A systematic scoping review of tDCS in PPA was conducted following our preregistered protocol on the Open Science Framework. From 532 identified articles, 40 met inclusion criteria for review and data extraction. (PRISMA diagram to be presented.)

We simulated three of the four most common montages (excluding the arm montage due to limited scan coverage) and added a fourth montage - L IFG (F7) – R SO - based on our modeling results showing suboptimal ROI targeting with extracephalic placements. Individualized 3D brain models were generated using Freesurfer (v7.4.1) from T1/T2 MRIs for three patients per PPA variant and three age-matched controls. Finite element meshes were created in SimNIBS (v4.01), refined in Gmsh, and mapped to the Brainnetome atlas. Simulations run in SimNIBS produced E-field metrics - E-mag, E-norm, and focality - calculated in MATLAB (R2023A).

Preliminary Results

We extracted montage details from the 40 articles and identified 32 unique electrode configurations. Only four were repeated across studies:

1. L IFG (F7) – R cheek (13 studies)
2. L DLPFC (F3) – R arm/deltoid (4 studies)
3. L IFG (F7) – L occipital (O1) (3 studies)
4. L parietal (P3) – R supraorbital (SO) (2 studies)

Most studies used the same montage across PPA variants, and only 13 studies identified a specific ROI. Of those, few used current modeling, often recycling the same model across studies within a group.

Preliminary simulation findings showed significant differences in E-field patterns between PWPPA and controls, with high (100%) inter-subject variability. ROIs receiving peak stimulation also varied by montage and PPA subtype, underscoring the importance of individualized targeting in tDCS for PPA.

Conclusions

More detailed information and models will be shown and discussed at time of presentation.

References

- Coemans, S., Struys, E., Vandenborre, D., Wilssens, I., Engelborghs, S., Paquier, P., ... & Keulen, S. (2021). A systematic review of transcranial direct current stimulation in primary progressive aphasia: methodological considerations. *Frontiers in Aging Neuroscience*, 13, 710818.
- Elsner, B., Kugler, J., & Mehrholz, J. (2020). Transcranial direct current stimulation (tDCS) for improving aphasia after stroke: a systematic review with network meta-analysis of randomized controlled trials. *Journal of Neuroengineering and Rehabilitation*, 17(1), 1-11.
- Fan, L., Li, H., Zhuo, J., Zhang, Y., Wang, J., Chen, L., ... & Jiang, T. (2016). The human brainnetome atlas: a new brain atlas based on connectional architecture. *Cerebral Cortex*, 26(8), 3508-35.
- Galletta, E. E., Cancelli, A., Cottone, C., Simonelli, I., Tecchio, F., Bikson, M., & Marangolo, P. (2015). Use of computational modeling to inform tDCS electrode montages for the promotion of language recovery in post-stroke aphasia. *Brain Stimulation*, 8(6), 1108-1115.
- Geuzaine, C., & Remacle, J-F. (2009). Gmsh: A Three-Dimensional Finite Element Mesh Generator with Built-in Pre- and Post-Processing Facilities. *International Journal for Numerical Methods in Engineering* 79 (11): 1309-1331.
- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., ... & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.
- Menardi, A., Rossi, S., Koch, G., Hampel, H., Vergallo, A., Nitsche, M. A., ... & Santarnecchi, E. (2021). Toward Noninvasive Brain Stimulation 2.0 in Alzheimer's Disease. *Ageing Research Reviews*, 101555.
- Mesulam, M. M., Coventry, C. A., Bigio, E. H., Sridhar, J., Gill, N., Fought, A. J., ... & Rogalski, E. J. (2022). Neuropathological fingerprints of survival, atrophy and

- language in primary progressive aphasia. *Brain*, 145(6), 2133-2148.
- Goswami, N., Shen, M., Gomez, L. J., Dannhauer, M., Sommer, M. A., & Peterchev, A. V. (2024). A semi-automated pipeline for finite element modeling of electric field induced in nonhuman primates by transcranial magnetic stimulation. *Journal of Neuroscience Methods*, 408, 110176.
- Puonti, O., Van Leemput, K., Saturnino, G. B., Siebner, H. R., Madsen, K. H., & Thielscher, A. (2020). Accurate and robust whole-head segmentation from magnetic resonance images for individualized head modeling. *Neuroimage*, 219, 117044.
- Unal, G., Ficek, B., Webster, K., Shahabuddin, S., Truong, D., Hampstead, B., ... & Tsapkini, K. (2020). Impact of brain atrophy on tDCS and HD-tDCS current flow: a modeling study in three variants of primary progressive aphasia. *Neurological Sciences*, 41(7), 1781-1789.

Acknowledgments

This work is funded by NIH NIDCD 3R01DC018282-02S1, NIH NIA P30AG086404, and NIH NIGMS, P20GM109089.

Perceived Causality in Aphasia Rehabilitation: Perspectives of People with Aphasia and Communication Partners

Nichol Castro^{1*}, Olivia A. Milonas¹, and Sameer A. Ashaie^{2,3}

¹ Communicative Disorders and Sciences, University at Buffalo, Buffalo, New York, USA

² Think+Speak Lab, Shirley Ryan AbilityLab, Chicago, Illinois, USA

³ Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

***corresponding author: nicholca@buffalo.edu**

Introduction

Understanding causality in aphasia rehabilitation is important for precision treatment planning. Many prognostic variables have been considered (Kristinsson et al., 2022; Plowman et al., 2012; Varkanitsa & Kiran, 2022),

including demographic, diagnostic, and psychosocial variables. Our prior study examined perceived causality among these variables from the perspective of speech-language pathologists (Castro & Ashaie, 2024), as clinicians hold valuable data on what variables impact their clients' rehabilitation outcomes.

The purpose of this study was to obtain additional perspectives of causality in aphasia rehabilitation by including persons with aphasia (PWAs) and their communication partners (CPs). As individuals with lived experience, they may also hold valuable insight.

Methods

Eight PWAs and two CPs completed the study, including two dyads (i.e., PWA and CP pair). All participants provided demographic and aphasia-related information and completed the perceived causality task. PWAs also completed the Quick Aphasia Battery, with most individuals demonstrating mild or latent aphasia (scores > 9.0; Wilson et al., 2018).

The perceived causality task was similar to our prior study (Castro & Ashaie, 2024), with aphasia-friendly instructions and materials. There were 18 prognostic variables selected from prior systematic reviews (Kristinsson et al., 2022). All variables were included in the prior study, with one new variable of speech-language therapy. Flashcards depicted a picture and written definition of each variable. There were also flashcards depicting arrows of differing thicknesses to reflect weak, medium, or high causal strength, as well as an 'X' to indicate no relationship.

The perceived causality task involved two steps. First, participants determined if each variable was important in aphasia rehabilitation. If they indicated yes, the variable was retained. Second, each pairwise combination of retained variables was presented. Participants indicated if there was a causal relationship by placing an arrow or 'X' flashcard between the two variable flashcards. Practice and guidance were provided to ensure understanding.

Results were analyzed using perceived causal network (Deserno et al., 2020; Frewan et al., 2012; Vogel et al., 2024). Nodes in the network represent prognostic variables. Edges in the network represent directed, weighted causal relationships between two variables as perceived by the participants. We calculated centrality metrics of the PWA group

network to determine the strongest causal variables and explored network differences in the two PWA-CP dyads.

Results

The PWA group network demonstrated strong causal relations between and among aphasia and psychosocial variables (Figure 1). Speech-language therapy had the strongest betweenness centrality, indicating its high importance in the network (Table 1). In addition, aphasia severity had a strong causal influence on other variables and participation was strongly impacted by other variables in the network. Individual differences in perceived causality are notable. Finally, one PWA-CP dyad (Figure 1, P7) showed more similar networks to each other, as compared to the other dyad (Figure 1, P8).

Conclusions

Our results highlight different perspectives of causality in aphasia rehabilitation among PWAs and CPs. As a group, PWAs perceived causality similarly to speech-language pathologists, particularly the role of participation (Casto & Ashaie, 2024). Additional analyses will examine whether individual network differences reflect experiences with prior speech therapy and/or their aphasia severity and time post-onset. Understanding what variables clients perceive as important to rehabilitation will support treatment planning by clinicians and broader research efforts to advance precision rehabilitation.

References

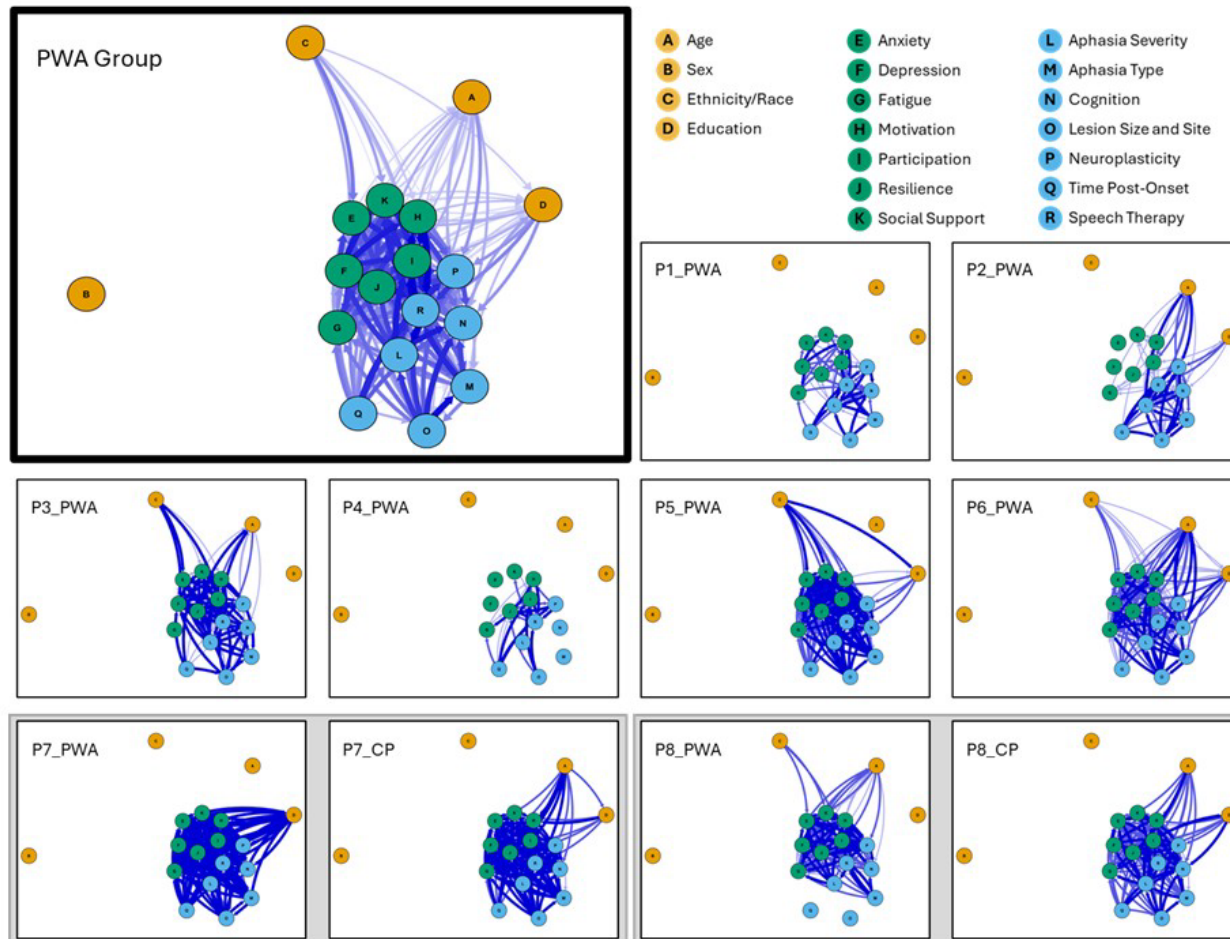
- Castro, N., & Ashaie, S. A. (2024). What Impacts What: Clinicians' Perspectives of Causality in Aphasia Rehabilitation. *American Journal of Speech-Language Pathology*, 33(6), 3012-3025.
- Deserno, M. K., Borsboom, D., Begeer, S., van Bork, R., Hinne, M., & Geurts, H. M. (2020). Highways to happiness for autistic adults? Perceived causal relations among clinicians. *Plos one*, 15(12), e0243298.
- Frewen, P. A., Allen, S. L., Lanius, R. A., & Neufeld, R. W. (2012). Perceived causal relations: novel methodology for assessing client attributions about causal associations between variables including symptoms and functional impairment. *Assessment*, 19(4), 480-493.
- Kristinsson, S., den Ouden, D. B., Rorden, C., Newman-Norlund, R., Neils-Strunjas, J., & Fridriksson, J. (2022). Predictors of therapy response in chronic aphasia: Building a foundation for personalized aphasia therapy. *Journal of Stroke*, 24(2), 189-206.
- Plowman, E., Hentz, B., & Ellis, C. (2012). Post-stroke aphasia prognosis: A review of patient-related and stroke-related factors. *Journal of Evaluation in Clinical Practice*, 18(3), 689-694.
- Varkanitsa, M., & Kiran, S. (2022). Understanding, facilitating and predicting aphasia recovery after rehabilitation. *International Journal of Speech-Language Pathology*, 24(3), 248-259.
- Vogel, F., Blanken, T., Burger, J., Reichert, J., Scholten, S., & Klintwall, L. (2024). How Perceived Causal Networks (PECAN) can complement case conceptualization, diagnostic classification and data-based networks: An introduction to a method for constructing personalized networks. OSF. <https://doi.org/10.31234/osf.io/7wfte>

Wilson, S. M., Eriksson, D. K., Schneck, S. M., & Lucanie, J. M. (2018). A quick aphasia battery for efficient, reliable, and multidimensional assessment of language function. *PloS One*, 13(2), e0192773.

Acknowledgments

Research reported in this presentation was supported by the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health under Award Number R21DC022357. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Figure 1. Perceived causal networks of all participants.



Note: PWA: Person with aphasia; CP: Communication partner. PWA and CP dyads are noted by the gray boxes. Darker, thicker edges represent stronger perceived causal relationships. Gold nodes = demographic variables; Green nodes = psychosocial variables; Light blue nodes = aphasia diagnostic and rehabilitation variables.

Table 1. Centrality metrics of nodes in the PWA group perceived causal network.

Node	Betweenness Centrality	In-Strength Centrality	Out-Strength Centrality
Age	-0.543	-0.848	-1.439
Sex	-0.543	-1.561	-2.483
Ethnicity/Race	-0.543	-1.561	-1.394
Education	-0.543	-0.806	-1.261
Anxiety	0.483	0.631	0.271
Depression	-0.543	0.757	0.560
Fatigue	-0.543	0.408	-0.350
Motivation	-0.111	0.896	0.471
Participation	-0.435	1.260	0.427
Resilience	0.105	0.575	0.560
Social Support	-0.543	0.743	0.338
Aphasia Severity	-0.003	0.170	1.071
Aphasia Type	-0.003	-0.751	0.382
Cognition	1.401	0.757	0.071
Lesion Size and Site	-0.543	-0.932	0.560
Neuroplasticity	-0.003	0.589	0.471
Time Post-Onset	-0.543	-1.561	0.360
Speech Therapy	3.454	1.232	1.382

Note. Betweenness centrality captures how often a node resides long the shortest path between other nodes in the network. Higher betweenness centrality indicates greater importance in the network, as these nodes act as critical bridges of the network. In-strength centrality captures the total incoming edge weight of a node in the network. Higher in-strength centrality indicates that the node is affected by other nodes in the network to a high degree. Out-strength centrality captures the total outgoing edge weight of a node in the network. Higher out-strength centrality indicates the node exerts a high degree of influence on other nodes in the network. All centrality values are z-scored for ease of interpretation. Red shading reflects negative centrality values. Green shading reflects positive centrality values. Darker shading reflects higher centrality, and lighter shading reflects lower centrality.

“Bridge Over Troubled Water:” An Overview of Music-Based Treatments as Neurological Bridges to Rehabilitation for Individuals with Aphasia

S. Alie Chandler*

Ossia Music Therapy, Chapel Hill, (North Carolina), USA

***corresponding author, ossiamusictherapy@gmail.com**

Introduction

Music therapy and music-based treatments may provide optimal environments for neuroplastic change for those with aphasia and related issues, given music’s multi-modal activation of the brain (Chatterjee, Hedge, & Thaut, 2021). Music therapy research supports its effectiveness in the domains of communication, cognition, and socio-emotional functioning for people with aphasia (Gong & Ye, 2024; Pfeiffer et al., 2024). Additionally, Melodic Intonation Therapy is considered an evidence-based approach for those with non-fluent aphasia (Popescu et al., 2022). Recent fMRI research with people with non-fluent aphasia has shown that singing techniques can bring about structural neuroplasticity changes in left frontal language areas and in bilateral language pathways, which underpin treatment-induced improvement in speech production (Sihvonen et al., 2024). Research on group singing techniques with those with chronic aphasia showed improved everyday communication and responsive speech production from baseline to 5-month stage, and longitudinally (Siponkoski et al., 2022). This study also found that the intervention enhanced patients’ social participation and reduced caregiver burden. Despite a substantial and growing research base, music therapy treatments in general remain somewhat unknown amongst other fields of therapy. The goal of this poster presentation is to increase awareness of these techniques and to encourage future interdisciplinary collaborations between music therapists and researchers and clinicians in other fields.

Methods

This poster will illustrate the neural networks involved in music-making, discussing fMRI images from recent studies. It will also visually represent music-based techniques for speech and language, including Neurologic Music Therapy® techniques of Melodic Intonation Therapy, Musical Speech Stimulation, Rhythmic Speech Cueing, and others. Socio-emotional music therapy research findings will also be included. Digital therapeutic music technology will be represented as well, as a way to improve access to music-based treatments for not only patients but other professional fields.

Results

Incorporation of music-based techniques by patients, clinicians, and caregivers can enhance many domains of functioning, patient engagement, and family interaction in the therapy process. In addition to creating new neural routes to speech and language, music therapy provides an avenue to emotional well-being (Pfeiffer et al., 2024).

Conclusions

This poster will expand attendees' knowledge of how music-based interventions build bridges to language/speech and well-being for individuals with aphasia and other neurological communication disorders.

References

- Chatterjee, D., Hegde, S., & Thaut, M. (2021). Neural plasticity: The substratum of music-based interventions in neurorehabilitation. *NeuroRehabilitation*, 48(2), 155–166. <https://doi.org/10.3233/NRE-208011>
- Gong, D., & Ye, F. (2024). Effects of Music Therapy on Aphasia and Cognition of Patients with Post-stroke: A Systematic Review and Meta-analysis. *Noise & health*, 26(121), 136–141. https://doi.org/10.4103/nah.nah_24_24
- Pfeiffer, C. F., Magee, W. L., Fülöp, R., Nace, T. C., Castro, C., Iturri, A., Franceschi, J., Echaury, G., Gassull, L., & Russo, M. J. (2024). Exploring Music-Based Interventions for Executive Functioning and Emotional Well-Being in Stroke Rehabilitation: A Scoping Review. *NeuroSci*, 5(4), 565–599. <https://doi.org/10.3390/neurosci5040041>
- Popescu, T., Stahl, B., Wiernik, B. M., Haiduk, F., Zemanek, M., Helm, H., Matzinger, T., Beisteiner, R., & Fitch, W. T. (2022). Melodic Intonation Therapy for aphasia: A multi-level meta-analysis of randomized controlled trials and individual participant data. *Annals of the New York Academy of Sciences*, 1516(1), 76–84. <https://doi.org/10.1111/nyas.14848>
- Sihvonen, A. J., Pitkäniemi, A., Siponkoski, S. T., Kuusela, L., Martínez-Molina, N., Laitinen, S., Särkämö, E. R., Pekkola, J., Melkas, S., Schlaug, G., Sairanen, V., & Särkämö, T. (2024). Structural Neuroplasticity Effects of Singing in Chronic Aphasia. *eNeuro*, 11(5), ENEURO.0408-23.2024. <https://doi.org/10.1523/ENEURO.0408-23.2024>
- Siponkoski, S. T., Pitkäniemi, A., Laitinen, S., Särkämö, E. R., Pentikäinen, E., Eloranta, H., Tuomiranta, L., Melkas, S., Schlaug, G., Sihvonen, A. J., & Särkämö, T. (2022). Efficacy of a multicomponent singing intervention on communication and psychosocial functioning in chronic aphasia: a randomized controlled crossover trial. *Brain communications*, 5(1), fcac337. <https://doi.org/10.1093/braincomms/fcac337>

Language experience and prediction across age groups: evidence from diachronic fine-tuning of language models

Alton Chao^{1*}, Ellis Cain¹, and Rachel Ryskin¹

¹ Cognitive and Information Sciences, University of California, Merced, Merced, (CA), United States

*corresponding author, achao28@ucmerced.edu

Introduction: Large language models (LLMs) have been proposed as a tool to help with aphasia treatment and rehabilitation (Manir, et al., 2024; Zeng, et al., 2023). However, LLMs are trained on internet text which might not reflect the way that the aphasia population would speak (e.g., internet texts do not reflect aphasic speech). Here we test how well an LLM predicts the language use of older adults (OA) versus younger adults (YA).

Methods: The experimental data set consists of 336 self-reported native English speakers, including 166 YA (18–35 years, $M = 24.7$) and 170 OA (50–80 years, $M = 64.1$). Each subject participated in a sentence completion task through Amazon Mechanical Turk. The cloze task consisted of 300 sentence preambles (e.g., ‘A dog has a good sense of ...’) from Wlotko and Federmeier (2012). Each participant provided a single-word completion for 150 sentence preambles, resulting in approximately 50,200 completions. We used a subset (11 decades) of the Cleaned Corpus of Historical American English (CCOHA; Alatrash, et al., 2020) for fine-tuning GPT-models (Radford et al., 2019). 6-fold cross validation was used to fine-tune the language models (6 folds per decade), following similar studies (Xu & Kemp, 2015; Hamilton, et al., 2016). Each decade of CCOHA was aggregated, randomized, then split into six folds. One fold was left out for validation and 20 percent of each fold was reserved for testing. GPT-2 was loaded and fine-tuned on CCOHA using HuggingFace’s Transformers library (Wolf et al., 2020). Each of the 66 resulting fine-tuned models were evaluated by computing perplexity (a measure of next word prediction) of the testing data for all decades. The default GPT-2 model served as a comparison baseline.

Results: Each fine-tuned model achieved the lowest average perplexity against the decade it was trained on, indicating successful fine-tuning (Table 1). Using all variations of the GPT-2 models, we calculated surprisal scores for each sentence stem for the corresponding best completion. Base GPT-2 surprisal values better predict YA contextual probabilities (how likely a completion was to be chosen among all completions) relative to OA contextual probabilities (See Fig. 1; R^2 YA = 0.253; R^2 OA = 0.194).

Conclusion: Across all the fine-tuned models, surprisal values explain more variance in YA responses than OA responses. As the model’s fine-tuning decade approaches modern day language usage, both YA and OA participants’ responses correlate more strongly with the surprisal scores. Additionally, for YA, the fine-tuned models from the most recent decades perform similarly to the default GPT-2. For OA, the fine-tuned models from the

most recent decades outperform the base GPT-2 model. While fine-tuning models results in similar trends across healthy YA and OA (i.e., recency trend), LLMs still predict language use differently. This both supports the necessity for aphasia-focused fine-tuned models, while also highlighting the underlying differences in language usage across population groups. Although fine-tuning has already been used to adapt LLMs to aphasic speech, there are still limitations in precision and amount of adaptation to the data.

References

- Alatrash, R., Schlechtweg, D., Kuhn, J., & Schulte im Walde, S. (2020). CCOHA: Clean corpus of historical American English. *Proceedings of the twelfth language resources and evaluation conference* (pp. 6958–6966).
- Hamilton, W. L., Leskovec, J., & Jurafsky, D. (2016, August). Diachronic word embeddings reveal statistical laws of semantic change. In K. Erk & N. A. Smith (Eds.), *Proceedings of the 54th annual meeting of the association for computational linguistics (volume 1: Long papers)* (pp. 1489–1501).
- Manir, S. B., Islam, K. M. S., Madiraju, P., & Deshpande, P. (2024). LLM-based text prediction and question answer models for aphasia speech. *IEEE Access*, 12, 114670–114680.
- Radford, A., Wu, J., Child, R., Luan, D., Amodei, D., & Sutskever, I. (2019). *Language Models are Unsupervised Multitask Learners.*, 24.
- Wlotko, E. W., & Federmeier, K. D. (2012). So that's what you meant! Event-related potentials reveal multiple aspects of context use during construction of messagelevel meaning. *NeuroImage*, 62(1), 356–366.
- Wolf, T., Debut, L., Sanh, V., Chaumond, J., Delangue, C., Moi, A., . . . Rush, A. (2020). Transformers: State-of-the-art natural language processing. *Proceedings of the 2020 conference on empirical methods in natural language processing: System demonstrations* (pp. 38–45).
- Xu, Y., & Kemp, C. (2015). A computational evaluation of two laws of semantic change. *Cognitive Science*.
- Zeng, Y., Tang, Q., Chen, S., & Chen, X. (2023). Integration of a large language model with augmentative and alternative communication tool for oncological aphasia rehabilitation. *Asia-Pacific journal of oncology nursing*, 11(2), 100344.

Acknowledgments

This fine-tuning and evaluation of these models was conducted using the Pinnacles cluster (NSF MRI, #2019144) at University of California, Merced.

Figure 1. Temporal trends in the coefficient of determination between surprisal and contextual probability, plotted against decades of model fine-tuning. Each point represents the R^2 between the surprisal from a given model and the contextual probability from a given age group. Fine-tuned models increasingly perform similarly to the default GPT-2 when evaluated on young adults but outperform the default GPT-2 when evaluated on older adults.

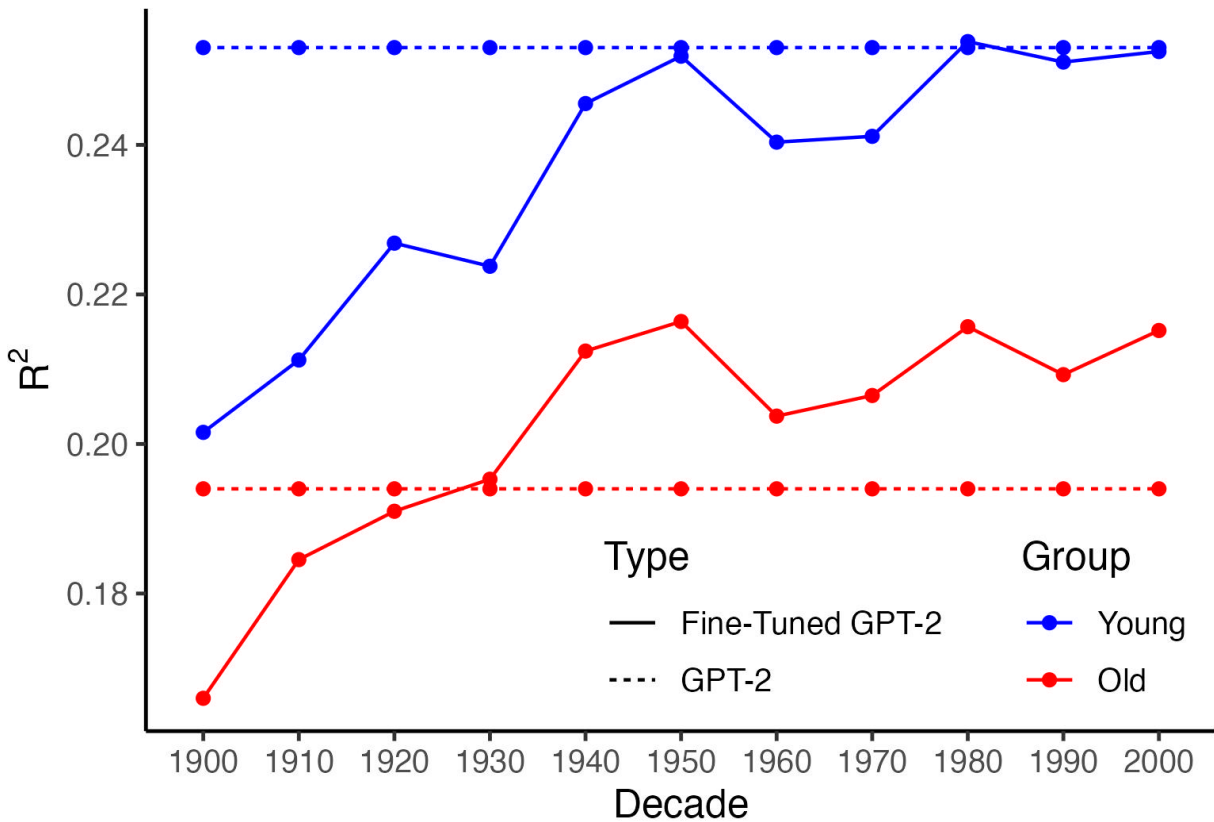


Table 1. Average perplexity with the rows represents the model fine-tuning decade (from CCOHA) and the columns represent the test decade (also from CCOHA). On average, perplexity was 19.96 lower when the fine-tuning decade matched, compared to the model’s performance on the other decades of corpus. The red numbers indicate the lowest perplexity score for a given model. As the temporal distance increased between the test and train decades, the difference in perplexity gradually increased. In general, these models were more attuned to the corpus text compared to the default GPT-2.

	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
1900	59.4	69.6	70.1	74.6	76.2	78	80.6	82	85.3	90.1	93.8
1910	66.9	57.9	65.8	69.8	71.1	72.8	75.2	76.7	80	84.2	87.7
1920	80.5	78.3	63.9	77	78.9	80.5	83.5	85.5	90.3	95.4	99.4
1930	86.7	83.9	77.6	68.3	75.2	76.5	79.6	82.1	86.1	92.1	96.7
1940	88.8	85.4	79.1	74.7	63.7	73	75.9	78.2	81.8	87.2	91.4
1950	93.9	90.5	82.7	77.2	74.2	63.7	75	77.5	81.2	86.7	90.9
1960	95.6	92.7	85.7	80	77.2	74.2	64.4	74.8	78.4	83.8	87.9
1970	98	95.1	88.5	82.2	79.4	76.5	74.7	64.4	76.3	81.4	85.1
1980	101.9	99.7	92.6	85.1	82.5	79.2	77.2	75.2	63.3	78.1	80.6
1990	99.5	96.6	89.6	83.4	80.6	77	74.4	72	70	58.1	67.7
2000	103.8	100.4	93	86.6	83.3	79.3	76.7	74	71.5	65.8	58.2
GPT2	181.7	176.9	195.5	192.8	190.3	191	184.6	181.9	177.5	160.6	159.2

Exploring Strategies to Foster Therapeutic Alliance in Aphasia Rehabilitation: Two Case Studies in Mainland China

Wenjun Chen¹, Anthony Pak-Hin Kong^{2,3*}, Mengbi Gu⁴ and Min Tang⁴

¹ School of Foreign Languages, Ningbo University of Technology, Ningbo, Zhejiang, China

² Academic Unit of Human Communication, Learning, and Development, The University of Hong Kong, Hong Kong SAR

³ Aphasia Research and Therapy (ART) Laboratory, The University of Hong Kong, Hong Kong SAR

⁴ Department of Neurological Rehabilitation, Ningbo Rehabilitation Hospital, Ningbo, China

*corresponding author, akong@hku.hk

Introduction and Aims

Aphasia rehabilitation research in mainland China has primarily emphasized on structured interventions, such as Constraint-Induced Language Therapy (Pulvermüller et al., 2001), Melodic Intonation Therapy (Albert et al., 1973), or Phonological Components Analysis (Leonard et al., 2008) and their measurable outcomes, including improved word retrieval (Boyle, 2004), increased accuracy on trained items (Kendall et al., 2013), and enhanced verbal output (Pulvermüller et al., 2001). This study aimed to examine how deliberate rapport-building—through closeness, trust, and motivation—could enhance treatment efficacy of aphasia. Through detailed case analyses of two people with aphasia (PWA) post-stroke, we demonstrated how therapeutic alliance dynamically had complemented conventional aphasia intervention, providing novel insights for personalized recovery strategies.

Methods

Two Mandarin-speaking chronic PWA (aged 23 and 50; see Table 1) with moderate aphasia (based on the Chinese version of Western Aphasia Battery [WAB]; Li et al., 2022) and high education level were recruited. They received two 30-minute sessions weekly for a total of six months with conventional language training (naming, repetition, picture description) combined with four alliance-building strategies: (1) personalizing interactions by engaging with their daily preferences; (2) designing rehabilitation materials tailored to their cognitive levels to balance challenge and engagement; (3) building rapport through shared interests, e.g., humor or values-based discussions; and (4) supporting broader life goals, including rehabilitation and career planning. Their progress was monitored using pre-post treatment gain in scores of WAB and Short Form of the Profile of Mood States (POMS-SF; Shacham, 1983). Their session records and clinician's notes on observed changes in communication behaviors and therapeutic compliance were systematically analyzed using thematic analysis (Braun & Clarke, 2006).

Results

Both participants showed improvements in their language functions as well as communication engagement and motivation. For the younger PWA, alliance-building strategies (2) and (3) were effective in enhancing his communication, and a 17-point gain in WAB AQ was found. Session notes documented increased verbal participation (e.g., naming 6–8 items per session compared to 2–3 initially) and frequent non-verbal engagement (e.g., smiling, sustained eye contact) when exercises incorporated favorite topics like music or hobbies. Additionally, his POMS-SF scores showed a reduction in depression, reflecting enhanced emotional well-being. For the middle-aged PWA, alliance-building strategies (3) and (4) yielded notable outcomes suggesting improved communication (15-point WAB AQ improvement) and motivation (POMS-SF vigor score increase). Session records also suggested his proactive behaviors, such as initiating career-related discussions and completing 70% of language tasks tied to professional goals, alongside increased confidence observed in relaxed demeanor and consistent task persistence. These divergent responses highlight that the efficacy of therapeutic alliance strategies depends on individual characteristics—such as age, personal context, and aspirations—with tailored approaches fostering trust and active participation. Further thematic analyses on both PWA session records and observations notes are in progress.

Conclusions

Tailored therapeutic alliance strategies, through personalized treatment materials for younger PWA and career-focused approaches for older PWA, may enhance engagement in aphasia rehabilitation. Further research on how individualized rapport-building can facilitate conventional aphasia therapy is warranted.

References

- Albert, M. L., Sparks, R. W., & Helm, N. A. (1973). Melodic intonation therapy for aphasia. *Archives of Neurology*, 29(2), 130-131.
- Boyle, M. (2004). Semantic feature analysis treatment for anomia in two fluent aphasia syndromes. *American Journal of Speech-Language Pathology*, 13(3), 236–249.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Kendall, D. L., et al. (2013). An analysis of aphasic naming errors as an indicator of improved linguistic processing following phonomotor treatment. *American Journal of Speech-Language Pathology*, 22(2), S240-S249.
- Li, J., Liang, Y., Ouyang, J., Lin, L., & Menjiu, Z. (2022). The Analysis of Validity and Reliability of the Chinese Version of the Western Aphasia Battery in Chinese Aphasia Patients. *Modern Linguistics*, 10(5), 1-8.
- Masson-Trottier, M., Marcotte, K., Rochon, E., Leonard, C., & Ansaldo, A. I. (2024). Effectiveness of French Phonological Components Analysis in individuals with chronic aphasia. *International Journal of Language & Communication Disorders*, 59(6), 2239-2264.
- Puermüller, F., et al. (2001). Constraint-induced therapy of chronic aphasia after stroke. *Stroke*, 32(7), 1621-1626.
- Shacham, S. (1983). A shortened version of the Profile of Mood States. *Journal of Personality Assessment*, 47(3), 305-306.

Table 1. Therapeutic Alliance Factors.

Participants	Most Effective Alliance-Building Strategies	Details on the Use of Effective Strategies	Observed Changes in Treatment Outcome Measures	Therapeutic Alliance Factors to the Improvements
PWA A • 23 years old • Male • Law undergraduate student • Left middle cerebral artery stroke • Broca's aphasia • 12 months post-onset	(2) Personalized materials	Designed language tasks incorporating PWA A's interests in music and pop culture, e.g., naming exercises using song titles and picture descriptions of favorite bands. Materials were tailored to moderate cognitive-linguistic demands, e.g., 5–7 word sentences to avoid frustration.	Session notes recorded <i>increased verbal participation</i>, e.g., naming 6–8 items per session (up from 2–3 initially) and producing short sentences (e.g., “I like rock”). <i>Non-verbal engagement</i> included frequent smiling, nodding, and sustained eye contact during music-related tasks.	Need for relevance and enjoyment
	(3) Shared interests	Engaged in discussions about music preferences (e.g., K-pop, rock) and humor (e.g., light-hearted banter about favorite artists), using these as prompts for conversation and repetition tasks.	<i>WAB AQ score</i> increased by 17 points (from 57 to 74), reflecting improved naming and fluency. <i>POMS-SF depression score</i> decreased from 8 to 4, indicating enhanced emotional well-being. These suggest heightened engagement and motivation.	
PWA B • 50 years old • Male • Civil servant with a MBA degree • Left temporal lobe infarction • anomic aphasia • 6 months post-onset		Built rapport through discussions on shared values, e.g., family and professional success, using topics like leadership anecdotes as conversation starters (e.g., “Describe a good	Session notes documented <i>proactive behaviors</i>, e.g., initiating discussions about career goals (e.g., “I want to lead again”) and completing 70% of tasks tied to professional terms.	Alignment with long-term goals

Participants	Most Effective Alliance-Building Strategies	Details on the Use of Effective Strategies	Observed Changes in Treatment Outcome Measures	Therapeutic Alliance Factors to the Improvements
		leader"). Incorporated humor via workplace-related jokes to prompt repetition tasks.	<i>Confidence</i> was observed in relaxed posture, consistent task persistence (e.g., attempting 10/12 naming items), and spontaneous word use (e.g., "profit").	
	(4) Rehabilitation/ career planning	Integrated career goals into therapy, such as naming tasks using business terms (e.g., "contract," "strategy") and picture descriptions of workplace scenarios (e.g., "Describe an office"). Supported long-term aspirations by discussing return-to-work plans, e.g., practicing phrases like "I manage projects."	<i>WAB AQ score</i> improved by 15 points (from 55 to 70), indicating better word retrieval. <i>POMS-SF vigor score</i> increased from 11 to 16, suggesting enhanced motivation. These reflect improved communication and confidence.	

Note: WAB AQ = Western Aphasia Battery Aphasia Quotient; POMS-SF = Profile of Mood States-Short Form

Classification of Aphasia Subtypes in Greek Speakers Using Artificial Intelligence

Andreas Chitos¹, Suzan D. Scheffer¹, and Tsegaye M. Tashu¹

¹Department of Artificial Intelligence, Bernoulli Institute, University of Groningen, Groningen, The Netherlands

***Corresponding author, a.chitos@student.rug.nl**

Introduction

Aphasia is a language disorder most commonly acquired after a stroke or a traumatic brain injury, which significantly impairs communication abilities. Among its subtypes, the non-fluent subtype, Broca's and the fluent subtype, Wernicke's aphasia, are the most frequent, each presenting distinct linguistic profiles. Accurate classification of aphasia subtypes is essential for clinical management and rehabilitation, but traditional assessments are resource-intensive and subject to inter-rater variability (Goutsos et al., 2011). Advances in natural language processing (NLP) and machine learning provide new opportunities for automating this process. This study presents a machine learning-based system for classifying aphasia type in Greek-speaking patients, focusing on binary classification between fluent and non-fluent aphasia using a custom feedforward neural network with three layers optimized for Greek-language features which is a novel approach compared to previous research (Cong, Lee, & LaCroix, 2024). This research aims to contribute to clinical decision-making processes through automated analysis of transcribed speech.

Methods

Speech data from Greek-speaking patients diagnosed with Broca's or Wernicke's aphasia were obtained from AphasiaBank (Goutsos et al., 2011; Varkanitsa et al., 2023). The data consisted of transcribed conversations between a patient and an investigator. Preprocessing involved extracting the patients' speech, converting the text to lowercase, and removing punctuation. Features were then extracted using Term Frequency–Inverse Document Frequency (TF-IDF) vectorization. To address class imbalance, the Synthetic Minority Oversampling Technique (SMOTE) was applied. A feedforward neural network was implemented with three hidden layers containing 256, 128, and 64 units, respectively. Batch normalization and dropout were used to improve generalization. The model was trained using the Adam optimizer and categorical cross-entropy loss, with early stopping and learning rate scheduling to optimize performance. Model evaluation was conducted on a held-out test set using accuracy, precision, recall, F1 score, and confusion matrix analysis.

Results

The neural network achieved robust performance, with a test accuracy of 0.91, precision of 0.92, recall of 0.91, and F1 score of 0.91.

The confusion matrix (Figure 1) showed perfect classification of Wernicke's aphasia (5/5 correct) and high accuracy for Broca's aphasia (5/6 correct, 1 misclassified as Wernicke's). These results demonstrate the model's effectiveness in distinguishing

between Broca's and Wernicke's aphasia. Training and validation curves showed rapid convergence and stable loss reduction across epochs.

Conclusions

This study demonstrates that machine learning and NLP can be effectively applied to classify Broca's and Wernicke's aphasia in Greek-speaking patients using transcribed speech. The neural network model achieved high accuracy and the ability to distinguish correctly between the two aphasia subtypes, supporting the integration of computational tools into clinical workflows for aphasia diagnosis. Future work will focus on expanding the dataset, refining feature extraction, and deploying a web application for clinical and research use.

References

- Goutsos, D., et al. (2011). The Corpus of Greek Aphasic Speech.
- Varkanitsa, M., et al. (2023). The PPlan-V Aphasia Corpus: Spoken Discourse Data from Greek-Speaking People with Aphasia.
- Cong, Y., Lee, J., & LaCroix, A. (2024). Leveraging pre-trained large language models for aphasia detection in English and Chinese speakers. Clinical NLP Workshop.

Acknowledgments

We thank [Aphasia TalkBank](#) for giving us access to all the resources that were needed for our project.

Figure 1. Confusion matrix for Broca's and Wernicke's aphasia classification.

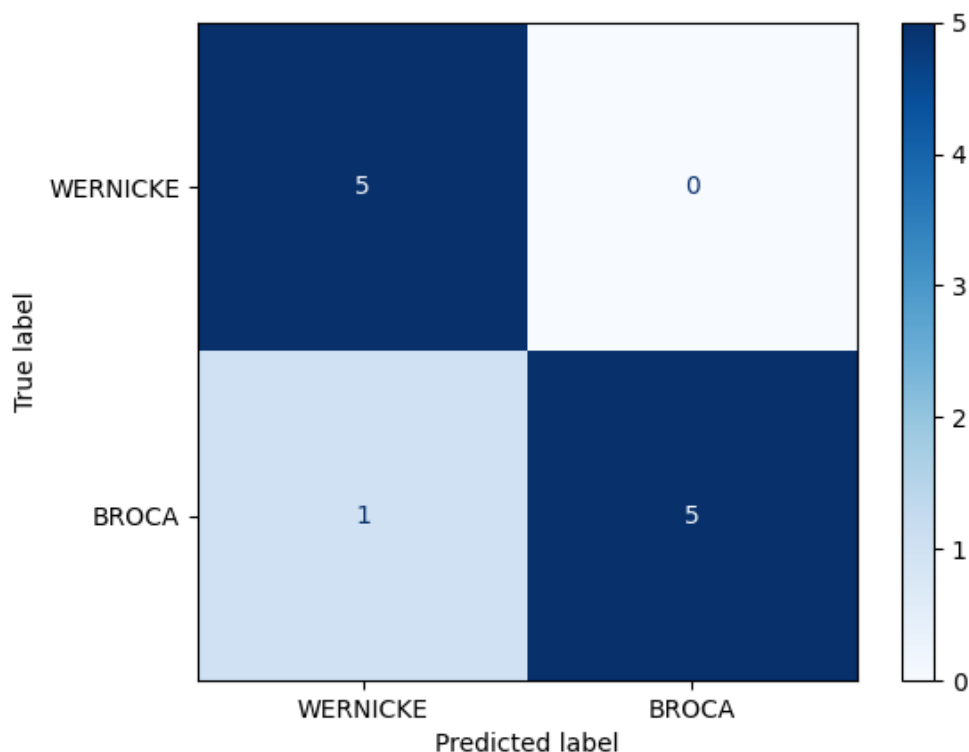


Table 1. Evaluation results from the model

Metric	Value
Accuracy	0.91
Precision	0.92
Recall	0.91
F1 score	0.91

Distributional semantic similarity enhances noun-verb priming for neurotypicals, but reduces it for people with aphasia

Sapna Chokshi^{1*}, Michael Walsh Dickey^{2,3}, Tessa Warren⁴, and Haley C. Dresang⁵

¹ Department of Health Informatics, University of Pittsburgh, Pittsburgh, PA, USA

² Department of Communication Sciences & Disorders, University of Pittsburgh, Pittsburgh, PA, USA

³ Geriatric Research Education and Clinical Center, VA Pittsburgh Healthcare System, Pittsburgh, PA, USA

⁴ Department of Psychology, University of Pittsburgh, Pittsburgh, PA, USA

⁵ Department of Communication Sciences & Disorders, University of Wisconsin–Madison, Madison, WI, USA

***corresponding author, sac395@pitt.edu**

Introduction

Neurotypical individuals (NIs) exhibit robust noun-to-verb priming for nouns that are event-related to verbs (e.g., McRae & Matsuki, 2009), like agents (chef–CHOP) or patients (onion–CHOP). Dresang et al. (2021) found that people with aphasia (PWA) exhibited greater event-related noun-verb priming than age-matched NIs, suggesting that PWA rely heavily on event knowledge to access verbs. This finding aligns with treatments like Verb Network Strengthening Treatment (VNeST: Edmonds, 2016), which use event-related nouns to facilitate verb and sentence production.

Distributional semantic similarity in models like word2vec (Mikolov et al., 2013) predicts the magnitude of semantic priming in NIs (Mandera et al., 2017), including event-related noun-verb priming (Brown et al., 2023). Word pairs with higher cosine values (higher semantic similarity) show greater priming. Furthermore, cosine values from spoken-language corpora better predict NIs' semantic priming than values from written-language corpora (Mandera et al., 2017). The current study used Dresang et al.'s (2021) data to examine whether distributional semantic similarity predicted and enhanced event-related noun-verb priming in PWA and NIs, and whether spoken- or written-language similarity scores better fit the data.

Methods

We reanalyzed Dresang et al.'s (2021) verb-naming accuracy data, which showed the strongest priming effects, via generalized mixed-effects models that included cosine values from pre-trained word2vec models trained on either written (Google News: Mikolov et al., 2013) or spoken (Twitter: Baziotis et al., 2017) corpora alongside fixed effects of group (NIs vs. PWA), condition (event-related vs. unrelated prime), and their interactions. These model structures allowed us to determine whether higher cosine values predicted increased event-related noun-verb priming. We also used AIC/BIC values and anova model comparisons to compare the fit of written- vs. spoken-language models.

Results

Model comparisons confirmed that including distributional semantic similarity (cosine value) as a predictor improved model fits. Furthermore, lower AIC/BIC values indicated that the spoken-language models showed better fit than written-language models, consistent with Mander et al. (2017). Replicating Dresang et al. (2021), both written-language and spoken-language models showed a robust interaction of group and condition (written-language: $\beta=3.65$, $p<.02$; spoken-language: $\beta=4.90$, $p<.01$). PWA showed more event-related noun-verb priming than NIs. Strikingly, there was also a three-way interaction of group, condition, and cosine value, particularly for the spoken-language model (written-language: $\beta=-21.75$, $p<.11$; spoken-language: $\beta=-21.40$, $p<.01$). Higher cosine values enhanced event-related priming for NIs but decreased it for PWA (Table 1).

Conclusions

Findings indicate that spoken-language distributional semantic models showed a better fit to NIs' and PWA's priming (Mander et al., 2017), and that including distributional-semantic similarity improved model fit. These findings suggest that distributional-semantic similarity captures additional variability in noun-verb priming. Furthermore, greater distributional-semantic similarity enhanced event-related noun-verb priming for NIs (Brown et al., 2023) but had the opposite effect for PWA. The reasons for this pattern are unclear: it may reflect outsized similarity-based semantic interference (Schnur et al., 2006) or noisy lexical-semantic representations (Dresang et al., 2024) among PWA. Regardless, this finding suggests that choosing event-related primes with higher distributional-semantic similarity is unlikely to enhance noun-verb priming or increase benefits of treatments like VNeST (Edmonds, 2016).

References

- Baziotis, C., Pelekis, N., & Doukeridis, C. (2017). *Datastories at semeval-2017 task 4: Deep lstm with attention for message-level and topic-based sentiment analysis*. 747–754.
- Brown, K. S., Yee, E., Joergensen, G., Troyer, M., Saltzman, E., Rueckl, J., Magnuson, J. S., & McRae, K. (2023). Investigating the Extent to which Distributional Semantic Models Capture a Broad Range of Semantic Relations. *Cognitive Science*, 47(5), e13291.
- Dresang, H. C., Warren, T., Hula, W. D., & Dickey, M. W. (2021). Rational Adaptation in Using Conceptual Versus Lexical Information in Adults With Aphasia. *Frontiers in Psychology*, 12, 32.
- Dresang, H. C., Warren, T., Hula, W. D., & Dickey, M. W. (2024). Rational adaptation in word production: Strong conceptual ability reduces the effect of lexical impairments on verb retrieval in aphasia. *Neuropsychologia*, 201, 108938.
- Edmonds, L. A. (2016). A Review of Verb Network Strengthening Treatment: Theory, Methods, Results, and Clinical Implications. *Topics in Language Disorders*, 36(2), 123–135.
- Mander, P., Keuleers, E., & Brysbaert, M. (2017). Explaining human performance in psycholinguistic tasks with models of semantic similarity based on prediction and counting: A review and empirical validation. *Journal of Memory and Language*, 92, 57–78.

- McRae, K., & Matsuki, K. (2009). People use their knowledge of common events to understand language, and do so as quickly as possible. *Language and Linguistics Compass*, 3(6), 1417–1429.
- Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). Efficient estimation of word representations in vector space. *arXiv Preprint arXiv:1301.3781*.
- Schnur, T. T., Schwartz, M. F., Brecher, A., & Hodgson, C. (2006). Semantic interference during blocked-cyclic naming: Evidence from aphasia. *Journal of Memory and Language*, 54(2), 199–227.

Acknowledgements

The authors are grateful to the Language and Brain Lab for experimental support. This work was supported by award F31 DC017896 to the last author. The first author's code for estimating spoken- and written-language word2vec cosine values may be found at: <https://colab.research.google.com/drive/1QcsMkiciNE9DixCXOaS5DOP2Q0Colli?usp=sharing>.

Table 1. Model-predicted accuracy by group and condition, written-language vs. spoken-language cosine values, first through fourth quartile cosine-value scores

	Written-language cosine values	Spoken-language cosine values	Written-language cosine values	Spoken-language cosine values
	<i>Event-related prime condition, NIs</i>		<i>Event-related prime condition, PWA</i>	
1st quartile cosine-value score	0.992	0.993	0.855	0.866
2nd quartile cosine-value score	0.995	0.994	0.846	0.844
3rd quartile cosine-value score	0.998	0.994	0.832	0.833
4th quartile cosine-value score	0.999	0.997	0.811	0.729
	<i>Unrelated prime (control) condition, NIs</i>		<i>Unrelated prime (control) condition, PWA</i>	
1st quartile cosine-value score	0.993	0.996	0.801	0.775
2nd quartile cosine-value score	0.982	0.984	0.799	0.741
3rd quartile cosine-value score	0.924	0.972	0.798	0.725
4th quartile cosine-value score	0.603	0.263	0.795	0.579

Relationship between verbal fluency and cognitive reserve in older adults

Nuria Cibeira^{**1}, Isabel González-Abraldes⁺¹, Julia Leira¹, Laura Lorenzo-López¹, Rocío López-López¹, Leire Lodeiro-Fernández¹, and Silvia Martínez-Ferreiro^{1,2}

¹ Gerontology and Geriatrics Research Group, Instituto de Investigación Biomédica de A Coruña (INIBIC), Complejo Hospitalario Universitario de A Coruña (CHUAC), SERGAS, Universidade da Coruña, A Coruña, Spain

² Department of Psychology, Faculty of Education Sciences, Universidade da Coruña, A Coruña, Spain

***corresponding author, nuria.cibeira@udc.es.**

+Equally contributing authors

Introduction

According to the Cognitive Reserve (CR) theory, the brain has the ability to enhance its networks of synaptic connections when exposed to enriched environments. Different studies indicate that engaging in cognitively stimulating activities in midlife correlates with better cognitive performance in old age (Potter et al., 2008), thus acting as a protective factor against deterioration.

Language deficits are a clinical manifestation of considerable magnitude in people with dementia (Maseda et al., 2014). A detailed analysis of the language profiles of healthy speakers and those with neurological conditions can reveal subtle and reliable indicators for detecting pathology in its early stages (Martínez-Ferreiro, 2024). Verbal fluency has been shown to be suitable for monitoring changes in cognitive performance over time (Bird et al., 2010).

In this study, we explore the relationship between CR and phonemic verbal fluency in a group of 58 Galician and Spanish speaking subjects with and without cognitive impairment to evaluate the potential of the latter as an easy-to-administer predictor of cognitive impairment.

Methods

The sample consisted of 58 individuals aged 65 years or older (mean: 77.8±9.4 years, 79.3% women) who underwent a comprehensive neuropsychological and linguistic evaluation as part of the SECONDS-GALES project.

Two tasks were selected: the Cognitive Reserve Questionnaire (CRQ) (Rami et al., 2011) and the verbal fluency subtest of the Spanish version of the Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005). The CRQ measures eight aspects of the subject's intellectual activity (education level, parent's educational level, training courses, occupational activity, musical training, languages, reading habit, and intellectual games). According to previous literature these are the most important variables for the formation of CR. In the verbal fluency subtest of the MoCA, subjects were asked to name as many words as possible beginning with the letter "P" within 60 seconds.

Data analysis was performed with SPSS (v29.01). Spearman's Rho partial correlation coefficient was used to evaluate the relationship between verbal fluency and CR in the group of participants.

Results

The results show a positive and significant correlation ($\rho = 0.66$, $p \leq 0.01$) between verbal fluency and CR (see Figure 1). This finding suggests that individuals with higher levels of CR tend to show superior performance on tasks related to verbal fluency. The observed correlation is consistent with the hypothesis that greater CR may act as a protective factor against the deterioration of cognitive skills.

Conclusions

This study reinforces the CR theory by demonstrating a significant positive correlation between CR and phonemic verbal fluency in older adults with and without cognitive impairment. Findings confirm that individuals with higher CR exhibit superior performance in verbal fluency tasks, supporting the notion that CR acts as a protective factor against cognitive decline. Our results align with previous studies investigating the relationship between the CR and neuropsychological performance (Wilson et al., 2002), and highlight the value of assessing verbal fluency as a potential marker for cognitive impairment. The exploitation of this predictive marker can then contribute to early detection and better characterization of age-related cognitive changes and dementia.

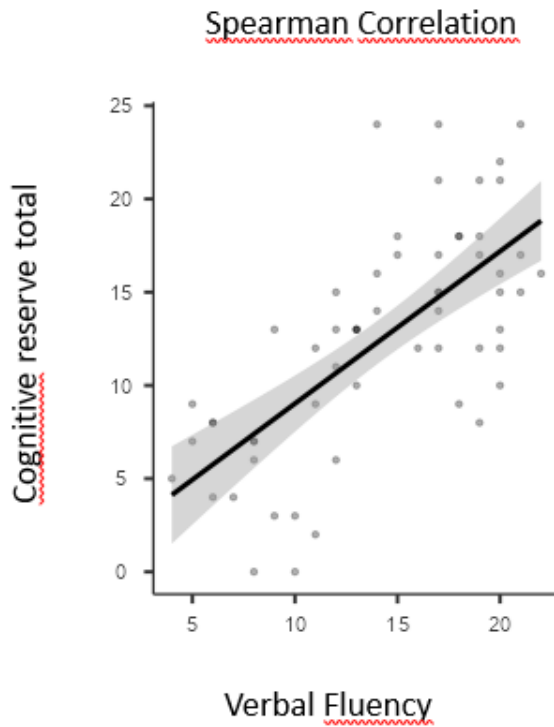
References

- Bird, C., Papadopoulou, K., Ricciardelli, P., Rossor, M., & Cipolotti, L. (2010). Monitoring cognitive changes: psychometric properties of six cognitive tests. *British Journal of Clinical Psychology*, 43, 2, 197-210.
- Martínez-Ferreiro, S. (2024). Naming as a window to word retrieval changes in healthy and pathological ageing: Methodological considerations. *International Journal of Language & Communication Disorders*, 59(1), 68-83.
- Maseda, A., Lodeiro-Fernández, L., Lorenzo-López, L., Núñez-Naveira, L., Balo, A., & Millán-Calenti, J.C. (2014). Verbal fluency, naming and verbal comprehension: three aspects of language as predictors of cognitive impairment. *Aging and Mental Health*, 18(8), 1037-1045.
- Nasreddine, Z.S., Phillips, N.A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J.L., & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society*, 53, 695-699.
- Potter, G.G., Helms, M.J., & Plassman, B.L. (2008). Association of job demands and intelligence with cognitive performance among men in late life. *Neurology*, 70, 1803-1808.
- Rami, L., Valls-Pedret, C., Bartrés-Faz, D., Caprile, C., Solé-Padullés, C., Castellví, M., Olives, J., Bosch, B., & Molinuevo, J.L. (2011). Cuestionario de reserva cognitiva. Valores obtenidos en población anciana sana y con enfermedad de Alzheimer. *Revista de Neurología*, 52, 4, 195-201.
- Wilson, R.S., Mendes de Leon, C.F., Barnes, L.L., Schneider, J.A., Bienias, J.L., Evans, D.A., & Bennett, D.A. (2002) Participation in cognitively stimulating activities and risk of incident Alzheimer disease. *Journal of the American Medical Association*, 2002, 287, 6, 742-748.

Acknowledgments

NC, IGA, RLL, LLF & SMF acknowledge support of PID2023-151673OB-I00, MCIN/AEI/10.13039/501100011033 & FEDER, EU. SMF also acknowledges support of RYC2020-028927-1, MICIU/AEI /10.13039/501100011033 y por El FSE invierte en tu futuro.

Figure 1. Scatterplot showing linear correlation between verbal fluency and cognitive reserve.



Cerebellar tDCS in Bilingual Aphasia: A Case Series on Language and Executive Function Outcomes in PPA and Post-Stroke Patients

Silke Coemans^{1*}, Anastasia Lada¹, Esli Struys^{1,2}, Kyrana Tsapkini^{3,4}, Vânia de Aguiar^{5,6}, Sebastiaan Engelborghs^{2,7,8}, Jean-Christophe Bier⁹, Philippe Paquier^{1,10}, Stefanie Keulen¹

¹Brussels Centre for Language Studies (BCLS), Vrije Universiteit Brussels (VUB), Brussels, Belgium

²Center for Neurosciences (C4N), Vrije Universiteit Brussels (VUB), Brussels, Belgium

³Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, USA

⁴Department of Cognitive Science, Johns Hopkins University, Baltimore, MD, USA

⁵Groningen Center for Language and Cognition (CLCG), University of Groningen, Groningen, The Netherlands

⁶Department of Radiation Oncology, University of Groningen, University Medical Center Groningen, The Netherlands

⁷Department of Neurology, Universitair Ziekenhuis Brussel (UZ Brussel), Brussels, Belgium ⁸Department of Biomedical Sciences, Universiteit Antwerpen (UA), Antwerp, Belgium

⁹Department of Neurology, CUB Hôpital Erasme, Université libre de Bruxelles (ULB), Brussels, Belgium

¹⁰Unit of Translational Neurosciences (Vakgroep Translationele Neurowetenschappen, TNW), Universiteit Antwerpen (UA), Antwerp, Belgium

***corresponding author, silke.coemans@vub.be**

Introduction

This case series explores the effects of cerebellar transcranial direct current stimulation (tDCS) on language and executive functions in bilingual individuals with aphasia. While tDCS has shown promise in modulating brain activity and facilitating language recovery in aphasia (Marangolo, 2020, Nissim et al., 2020), its potential for bilingual populations—and its application to cerebellar regions—remains underexplored. The search for optimal stimulation parameters and targets is ongoing (Coemans et al. 2021), and the cerebellum is a compelling candidate, given its dense structural connections to cortical language areas (Middleton & Strick, 2001; Schmahmann, 2001), as well as its role in both language processing and executive control (Jobson et al., 2022). We present a series of Dutch-French bilingual cases diagnosed with Primary Progressive Aphasia (PPA) or post-stroke non-fluent aphasia, examining the impact of cerebellar tDCS in combination with speech and language therapy (SLT).

Methods

The series includes one participant with non-fluent variant PPA (nfvPPA), three with logopenic variant (lvPPA), one with semantic variant (svPPA), and two with post-stroke non-fluent aphasia. In a within-subject, sham-controlled crossover design, participants received 20 minutes of 2mA anodal or sham tDCS targeting the right posterolateral cerebellum, combined with SLT. Each stimulation phase included nine sessions over

three weeks. Pre- and post-assessments involved neuropsychological testing in both languages, including a personalized naming task, subtests of the Bilingual Aphasia Test, the Boston Naming Test, and executive function tasks (Stroop, Attention Network Test). SLT was tailored to each participant's deficits and delivered in their language of choice, though the personalized naming task was trained for all.

Results

Cerebellar tDCS was associated with greater improvements in language outcomes for six of seven participants, and in executive function for two. Gains were observed in both trained and untrained items and in both languages across language domains including naming, word and nonword repetition, and sentence comprehension. Notably, improvements occurred even in the untreated language, suggesting cross-linguistic generalization in all three PPA subtypes and in post-stroke aphasia. While two participants showed gains on the Attention Network Test, Stroop task outcomes varied widely across individuals and timepoints.

Conclusions

These findings contribute to growing evidence that cerebellar tDCS can support language recovery in a range of (bilingual) aphasia subtypes, with effects extending across linguistic domains and languages (Coemans et al., 2024; Sebastian et al., 2017; Sebastian et al., 2020). The positive outcomes on tasks related to phonological, semantic, and syntactic processing point to the cerebellum's broad modulatory role in language. Mixed results on executive function tasks suggest that cerebellar stimulation may also influence domain-general processes such as inhibitory control (Mannarelli et al., 2019), though effects appear task- and participant-specific. Further research is needed to refine assessment approaches and to determine optimal stimulation protocols for different aphasia profiles.

References

- Coemans, S., Struys, E., De Aguiar, V., | Paquier, P., | Tsapkini, K., Engelborghs, S., Keulen, S. (2024). Effects of Cerebellar Transcranial Direct Current Stimulation in Bilingual Logopenic Primary Progressive Aphasia. *Journal of Alzheimer's Disease Reports*, vol. 8, no. 1, pp. 1253-1273, 2024 1 June. 2024 : 1253 – 1273.
- Coemans, S., Struys, E., Vandenborre, D., Wilssens, I., Engelborghs, S., Paquier, P., Tsapkini, K., & Keulen, S. (2021). A Systematic Review of Transcranial Direct Current Stimulation in Primary Progressive Aphasia: Methodological Considerations. *Frontiers in Aging Neuroscience*, 13, 710818. <https://doi.org/10.3389/fnagi.2021.710818>
- Jobson, K. R., Hoffman, L. J., Metoki, A., Popal, H., Dick, A. S., Reilly, J., & Olson, I. R. (2022). Language and the Cerebellum: Structural Connectivity to the Eloquent Brain. *Neurobiology of Language*, 1-24. https://doi.org/10.1162/nol_a_00085
- Mannarelli, D., Pauletti, C., Currà, A., Marinelli, L., Corrado, A., Delle Chiaie, R., & Fattapposta, F. (2019). The Cerebellum Modulates Attention Network Functioning: Evidence from a Cerebellar Transcranial Direct Current Stimulation and Attention Network Test Study. *Cerebellum*, 18(3), 457-468. <https://doi.org/10.1007/s12311-019-01014-8>

- Marangolo, P. (2020). The potential effects of transcranial direct current stimulation (tDCS) on language functioning: Combining neuromodulation and behavioral intervention in aphasia. *Neuroscience Letters*, 719, 133329. <https://doi.org/https://doi.org/10.1016/j.neulet.2017.12.057>
- Middleton, F., & Strick, P. (2001). Cerebellar Projections to the Prefrontal Cortex of the Primate. *The Journal of Neuroscience*, 21(2), 700-712. <https://doi.org/10.1523/jneurosci.21-02-00700.2001>
- Nissim, N. R., Moberg, P. J., & Hamilton, R. H. (2020). Efficacy of Noninvasive Brain Stimulation (tDCS or TMS) Paired with Language Therapy in the Treatment of Primary Progressive Aphasia: An Exploratory Meta-Analysis. *Brain Sciences*, 10(9), 597. <https://www.mdpi.com/2076-3425/10/9/597>
- Schmahmann, J. D. (2001). The cerebrocerebellar system: anatomic substrates of the cerebellar contribution to cognition and emotion. *International Review of Psychiatry*, 13(4), 247-260. <https://doi.org/10.1080/09540260120082092>
- Sebastian, R., Kim, J. H., Brenowitz, R., Tippet, D. C., Desmond, J. E., Celnik, P. A., & Hillis, A. E. (2020). Cerebellar neuromodulation improves naming in post-stroke aphasia. *Brain Commun*, 2(2), fcaa179. <https://doi.org/10.1093/braincomms/fcaa179>
- Sebastian, R., Saxena, S., Tsapkini, K., Faria, A. V., Long, C., Wright, A., Davis, C., Tippet, D. C., Mourdoukoutas, A. P., Bikson, M., Celnik, P., & Hillis, A. E. (2017). Cerebellar tDCS: A Novel Approach to Augment Language Treatment Post-stroke [Case Report]. *Frontiers in Human Neuroscience*, 10. <https://doi.org/10.3389/fnhum.2016.00695>

Acknowledgments

Silke Coemans's research is supported by the Research Foundation-Flanders (FWO) under grant number FWOAL938-Junior Research Project. Vânia de Aguiar's work is funded by the project "Verb processing and verb learning in children with pediatric posterior fossa tumors" (Project number VI.Vidi.201.003) within the NWO Talentprogramma Vidi SGW 2020, financed by the Dutch Research Council (NWO). Kyrana Tsapkini's research is supported by grants from the Science of Learning Institute at Johns Hopkins University, as well as NIH/NIA (R01 AG068881, R01AG075404, R01AG075111).

Language models derived surprisal and structural priming in aphasia: Implications for language recovery

Yan Cong^{1*}, Jiyeon Lee²

¹ School of languages and cultures, Purdue University, West Lafayette, U.S.A.

² Department of Speech, Language and Hearing Sciences, Purdue University, West Lafayette, U.S.A.

*corresponding author, cong4@purdue.edu

Introduction

Aphasia presents challenges in rehabilitation due to highly variable treatment outcomes. Recent studies have shown that surprisal, a measure derived from language models (LMs), can effectively detect aphasia and its subtypes during discourse tasks (Cong et al., 2024; Rezaii et al., 2023). Building on this, the present study investigates whether LM-based surprisal scores can track language improvement following structural priming training. Structural priming refers to the unconscious repetition of syntactic structures and plays a key role in implicit language learning (Ferreira & Pickering, 2008). It has shown therapeutic promise in aphasia by enhancing access to syntactic representations (Lee, 2024). Notably, individuals with more severe syntactic impairments often benefit more from priming, a phenomenon called the inverse preference effect.

Methods

Data are from 24 persons with post-stroke aphasia (mean age: 59, SD = 11; WAB AQ: 63-96; post-onset time: 23-245 months) and 16 healthy controls (mean age: 63). Before and one-day and one-week after 3 sessions of structural priming training (Lee et al., 2025), the participants performed a production task. Participants were free to produce either double object (DO) or prepositional object (PO) dative sentences. Because the priming training specifically aimed to improve choices of DO structures in the participants' production responses, the participants' responses were evaluated based on how closely they aligned with the expected target DO structure. For the LM experiments, we computed GPT-2 surprisal as a proxy to the alignment between participant productions and target forms. First, we hypothesized that both participants with post-stroke aphasia (APH) and age-matched controls should show reduced surprisal following training, with greater reductions expected in APH due to higher baseline surprisal. Further, we explored how surprisal correlates with various lexical and syntactic production errors, computing Spearman correlations between surprisal scores and the one-hot-encoded counts of each error category.

Results

Surprisal decreased following structural priming training, especially in participants with more severe baseline impairments (Fig. 1). This pattern reflected the inverse preference effect, where those less likely to use a structure at baseline show greater learning after priming training. GPT-2 surprisal revealed distinct patterns of correlation with different types of linguistic errors, suggesting the model's sensitivity to specific disruptions in

language. Grammatical errors showed the strongest positive correlation with surprisal ($r = 0.277$, $p < 0.001$), followed by non-sentential utterances lacking a lexical verb ($r = 0.195$, $p < 0.001$). These results suggested that GPT-2 is particularly attuned to structural violations that go beyond isolated word-level anomalies. Lexical errors demonstrated a weaker but still significant positive correlation ($r = 0.088$, $p = 0.006$), indicating that while lexical disruptions contribute to increased surprisal, their impact is comparatively limited.

Conclusions

Our analyses showed a practical approach for modeling language rehabilitation, tracking not only language structure but also individual change over time in clinical contexts. We maintain that LM-surprisal can serve as a sensitive, quantifiable marker of recovery that can account for individual variability. Ultimately, our findings seek to inform more personalized and effective treatment strategies by leveraging both human priming mechanisms and LM-based linguistic modeling.

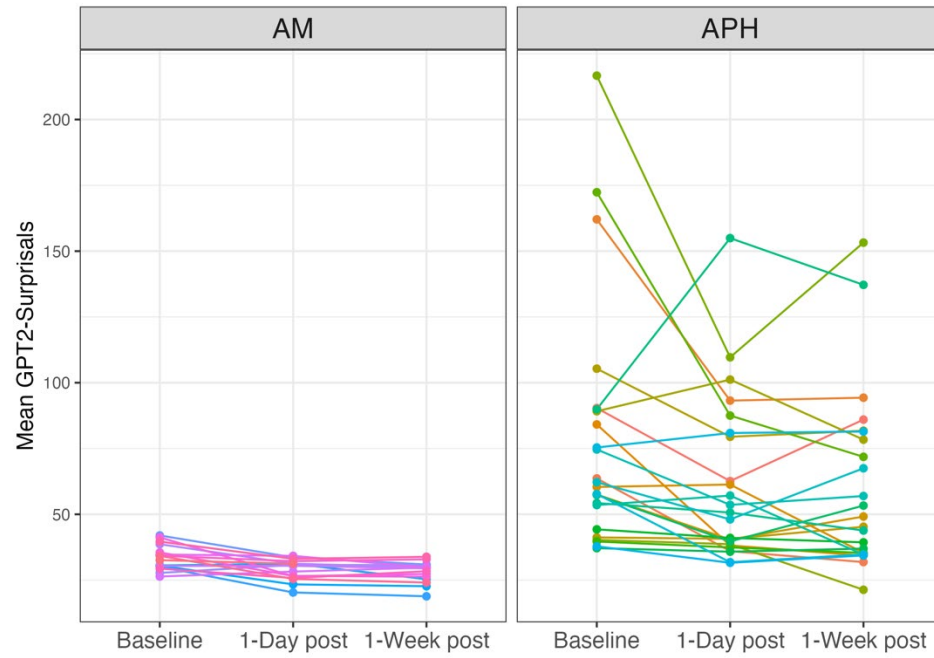
References

- Lee, J. (2024). Structural priming in aphasia: a state-of-the-art review and future directions. *Aphasiology*, 1-34. <https://doi.org/10.1080/02687038.2024.2445660>
- Lee, J., van Boxtel, W. S., Weirick, J. D., Ferreira, V., Martin, N., Bauman, E. L., Haven, L.N., Sayers, M.J. & Manning, R. G.C. (2025). Implicit structural priming as a treatment component for aphasia: Specifying essential learning conditions. *Cognitive Neuropsychology*, 1-25. <https://doi.org/10.1080/02643294.2025.2479485>
- Rezaii, N., Michaelov, J., Josephy-Hernandez, S., Ren, B., Hochberg, D., Quimby, M., & Dickerson, B. C. (2023). Measuring sentence information via Surprisal: theoretical and clinical implications in nonfluent aphasia. *Annals of Neurology*, 94(4), 647-657. <https://doi.org/10.1002/ana.26744>
- Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: a critical review. *Psychological bulletin*, 134(3), 427. <https://doi.org/10.1037/0033-2909.134.3.427>
- Cong, Y., LaCroix, A. N., & Lee, J. (2024). Clinical efficacy of pre-trained large language models through the lens of aphasia. *Scientific Reports*, 14(1), 15573. <https://doi.org/10.1038/s41598-024-66576-y>

Acknowledgments

This work was supported by NIH R01DC019129.

Figure 1. Trajectories of GPT-2 surprisal scores for each participant at baseline, 1-day, and 1-week post structural priming training. AM = age-matched controls; APH = participants with post-stroke aphasia.



Development of Speech-Based Metrics for The Assessment of Speech and Language Abilities in Primary Progressive Aphasia

Sabia Costantini^{1*}, Lisa Wauters², Carly Millanski², Heather R. Dial³, Maya L. Henry²

¹ Department of Linguistics, University of Potsdam, Potsdam, Brandenburg, Germany

² Department of Speech, Language, and Hearing Sciences, University of Texas, Austin, TX, USA

³ Department of Communication Sciences and Disorders, University of Houston, Houston, TX, USA

*corresponding author, costantini@uni-potsdam.de

Introduction

Speech and language abilities in individuals with Primary Progressive Aphasia (PPA) are commonly assessed using standardized test batteries. While widely used, these test batteries are time-intensive to administer and score, placing a considerable burden on clinicians and imposing cognitive and emotional demands on patients (Gallée et al., 2023). Furthermore, some assessments rely on subjective scoring procedures, which may lead to inaccurate evaluations of an individual's abilities. Automated speech analysis has recently emerged as a low-burden, objective method for assessing speech and language abilities in individuals with PPA. In a recent study, features extracted from connected speech data were used to generate a composite score capturing *global* language impairment in individuals with PPA (Robin et al., 2023). Clinical decision-making, however, requires an understanding of a patient's impairment in *specific* language domains. In this study, we aim to identify a set of connected speech measures that demonstrate strong clinical utility, operationalized as good reliability and alignment with gold standard clinical metrics that capture central areas of impairment in PPA, including lexical-semantic, phonological, syntactic, and motor speech domains. We also introduce measures to assess speech fluency, efficiency, and conciseness, which together provide an overview of broader communication abilities. This addition is particularly important because although the ability to communicate efficiently and fluently is a primary concern for individuals with PPA and a key treatment outcome, objective metrics for its assessment remain limited.

Methods

As part of a larger clinical trial (ClinicalTrials.gov ID NCT04881617), individuals with PPA (n = 60) described the Picnic scene from the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2007). Speech samples are being transcribed and annotated using CLAN (MacWhinney et al., 2011) to extract speech features. Additional features will be derived using SpaCy (<https://spacy.io/>) and SPLAT (Burgasser, 2017). Factor analyses will be used to identify feature sets corresponding to specific language domains. Confirmatory factor analysis will be conducted first, based on predefined hypotheses about which features correspond to specific language domains. Exploratory factor analysis will then be performed to investigate whether features group together in different, potentially more

accurate ways for each domain. To assess feature reliability, features will be compared across two connected speech tasks. For this purpose, speech from the Cat Rescue storytelling task (Nicholas & Brookshire, 1993) will be analysed for a subset of participants ($n = 25$). Only features with good to high reliability ($ICC > 0.75$; Koo & Li, 2016) will be retained and aggregated into composite metrics for each language domain. Clinical validity of domain-specific metrics will be evaluated through correlations with standardized language assessments. Table 1 shows a selection of speech features that will be extracted for each domain, and the clinical language tests used to validate the speech-based metrics.

Results

Data processing is underway. Results will be presented during the conference.

Conclusions

With the development of these speech-based metrics, we aim to offer a granular assessment of language and speech abilities in individuals with PPA, with the potential to serve as a low-burden and objective supplementary test for use in clinical settings.

References

- Burgasser, A. J. (2017). The SpeX Prism Library Analysis Toolkit (SPLAT): a data curation model. *arXiv preprint arXiv:1707.00062*.
- Gallée, J., Cartwright, J., Volkmer, A., Whitworth, A., & Hersh, D. (2023). "Please don't assess him to destruction": The RaISE assessment framework for primary progressive aphasia. *American Journal of Speech-Language Pathology*, 32(2), 391-410.
- Howard, D. & Patterson, K. (1992). *The Pyramids and Palm Trees Test. A test of semantic access from words and pictures*. Thames Valley Company.
- Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *Boston naming test*. Lea & Febiger.
- Kertesz, A. (2007). *Western Aphasia Battery–Revised*. The Psychological Corporation.
- Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of chiropractic medicine*, 15(2), 155-163.
- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for studying discourse. *Aphasiology*, 25(11), 1286-1307.
- Nicholas, L. E., & Brookshire, R. H. (1993). A system for quantifying the informativeness and efficiency of the connected speech of adults with aphasia. *Journal of Speech, Language, and Hearing Research*, 36(2), 338-350.
- Robin, J., Xu, M., Kaufman, L. D., Simpson, W., McCaughey, S., Tatton, N., ... & Ward, M. (2023). Development of a Speech-based Composite score for remotely quantifying Language changes in Frontotemporal Dementia. *Cognitive and Behavioral Neurology*, 36(4), 237-248.
- Weintraub, S., Mesulam, M. M., Wieneke, C., Rademaker, A., Rogalski, E. J., & Thompson, C. K. (2009). The northwestern anagram test: measuring sentence production in primary progressive aphasia. *American Journal of Alzheimer's Disease & Other Dementias®*, 24(5), 408-416.

Werzt, R.T, LaPointe, L.L., & Rosenbek, J.C. (1984). *Apraxia of speech: The disorders and its management*. Grune & Stratton.

Acknowledgments

This work was supported by the NIH/NIDCD R01DC016291 grant awarded to Maya L. Henry. We want to thank the members of the Aphasia Research and Treatment Lab who contributed to participant assessment, care, and data processing. Most importantly, we sincerely thank our participants and their loved ones for their hard work and dedication.

Table 1. Selection of Connected Speech Features by Domain and Corresponding Clinical Language Tests for Validation.

Domain of impairment	Corresponding Clinical Test	Connected Speech Feature
Lexical-Semantic/Core Semantic	WAB-R (Kertesz, 2007): Object Naming Word fluency (semantic) Pyramids and Palm Trees Test (Howard & Patterson, 1992) Boston Naming Test (Kaplan et al., 1983)	Number of correctly retrieved nouns from picture, ratio of different words relative to the total number of words used, pauses before noun in NP (total number and duration per pause), word frequency, number of deictic terms/expressions (i.e., “this”, “that”, “this thing”), lexical richness
Phonology	WAB-R (Kertesz, 2007): Repetition Object Naming Boston Naming Test (Kaplan et al., 1983), number of words retrieved after phonemic cue	Number of phonological paraphasias, phonological complexity (syllables per sentence, mean word length in phonemes)
Speech timing (motor speech)	Motor speech evaluation apraxia and dysarthria ratings (Wertz et al., 1984)	Syllable and mean pause durations in discourse (excluding pauses before nouns), ratio of speech to pause time, overall articulation rate
Syntax	Northwestern Anagram Test-Short Form (NAT; Weintraub et al., 2009)	Frazier score, Type-Token Ratio (TTR) in Syntactic Constructs (counts variety of syntactic structures used in a sample of speech; higher score reflects the ability to use a higher variety of structures)
Communication effectiveness	WAB-R (Kertesz, 2007) spontaneous speech clinician scoring criteria	<u>Fluency</u> Number of fillers, pauses, articulation rate <u>Efficiency</u> Rate at which meaningful information is conveyed over time, calculated by dividing the total number of information units by the duration in seconds of the speech sample <u>Conciseness</u> Calculated by dividing the number of ideas expressed by the total number of words (idea density)

Language Follow-Up and Intervention in Different Stages of Alzheimer's Disease

**Oona Cromheecke^{1,2*}, Emma Depuydt³, Marta Scarioni^{4,5}, Marijke Miatton^{4,5,6},
Arnaud Szmalec^{7,8}, Pieter Van Mierlo³, Miet De Letter², and Evy Woumans¹**

¹ Department of Translation, Interpreting and Communication, Ghent University, Ghent, Belgium

² Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium

³ Department of Electronics and Information Technology, Ghent University, Ghent, Belgium

⁴ Department of Neurology, Ghent University Hospital, Ghent, Belgium

⁵ Cognitive Centre, Ghent University Hospital, Ghent, Belgium

⁶ Department of Head and Skin, Ghent University, Ghent, Belgium

⁷ Psychological Sciences Research Institute, University of Louvain, Louvain-la-Neuve, Belgium

⁸ Department of Experimental Psychology, Ghent University, Ghent, Belgium

***corresponding author, oonacromheecke@ugent.be**

Introduction

Semantic processing is often affected in Alzheimer's Disease (AD) as shown by reduced behavioral accuracies, as well as decreased amplitudes and increased latencies of the N400 event-related potential (ERP) component (Joyal et al., 2020). However, longitudinal data fully portraying this semantic decline remains scarce (Blair et al., 2007; Forbes-McKay et al., 2013). Hence, this study has two main aims: (1) to follow up language decline across the different stages of AD; and (2) to implement a multiple pretest-posttest lexical-semantic intervention designed to preserve or foster language skills and support daily communication. The current abstract focuses on presenting our protocol **(A)** and highlights its feasibility in two AD patients **(B)**.

Methods

A: The yearly follow-up consists of quality of life, communication and participation questionnaires, as well as behavioral language and cognitive assessments. A subset of the patients also undergoes electroencephalography (EEG) recordings, during which the N400, mismatch negativity (MMN), and P300 ERP components are elicited.

In addition to the yearly follow-up, participants can also take part in a language intervention. This intervention procedure consists of two pretests administered three weeks apart, followed by a three-week lexical-semantic training (five hours per week) using the Speech Therapy App (STAPP; Feiken et al., 2020), and posttests administered immediately thereafter, and after three and six months. The effects of the intervention are again quantified by behavioral and ERP measures, complemented by a subjective satisfaction questionnaire.

B: We present preliminary results of two participants who completed the intervention procedure. Patient 1 was a 57-year-old man with Mild Cognitive Impairment (MCI), and patient 2 was a 77-year-old woman with mild AD. The classification of the AD stage was based on neuropsychological testing, neuroimaging, and cerebrospinal fluid biomarkers.

Behavioral tests included the verbal and non-verbal Semantic Association Test (SAT) and the Test Relations Abstract Concepts (TRACE), whereas the N400 was elicited during an auditory word priming paradigm.

Results

Behaviorally, neither patient 1 nor patient 2 showed notable deficits on the SAT across the three evaluation moments, whereas patient 2 obtained a below-average score on the TRACE at the first evaluation. Electrophysiologically, in patient 1, the N400 component was consistently present and fell within normative ranges for both amplitude and latency at all three evaluation moments (Cocquyt et al., 2021). However, in patient 2, the N400 component was absent at both pretests, but appeared – albeit with a delayed onset and an atypical topographical distribution (see Figure 1) – following the intervention. Furthermore, the subjective questionnaire revealed high satisfaction with the content, duration and format of the intervention.

Conclusions

Based on these preliminary data, our protocol appears to be feasible in different stages of AD. For these two patients, disease stages (i.e., MCI and mild AD) could be differentiated based on the results of the TRACE at the first evaluation moment and the presence or characteristics of the N400-effect at each evaluation moment. Regarding language intervention effects, there were no behavioral differences between the pretests and the posttest in either patient. However, the N400-effect was influenced by the language intervention in mild AD. Finally, both patients reported high satisfaction with the intervention procedure.

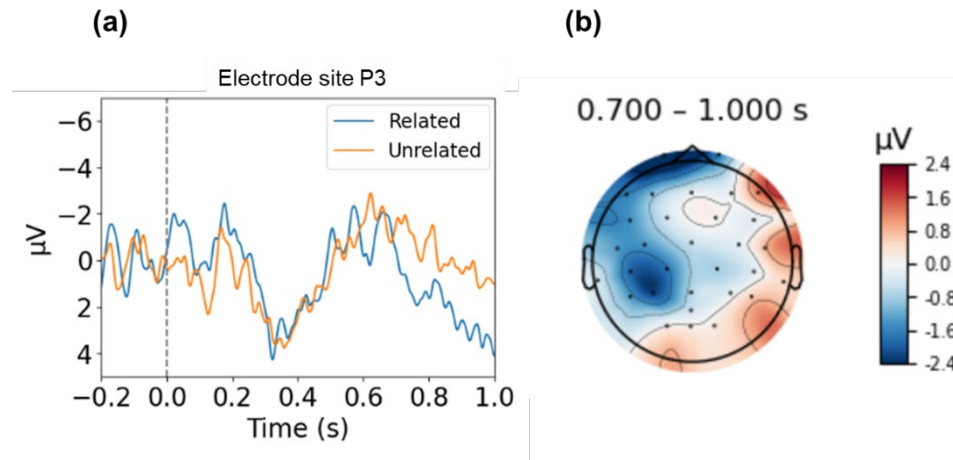
References

- Blair, M., Marczyński, C.A., Davis-Faroque, N., & Kertesz, A. (2007). A longitudinal study of language decline in Alzheimer's disease and frontotemporal dementia. *Journal of the International Neuropsychological Society*, 13(02), 237–245.
- Cocquyt, E.-M., Santens, P., van Mierlo, P., Duyck, W., Szmalec, A., & De Letter, M. (2021). Age- and gender-related differences in verbal semantic processing: The development of normative electrophysiological data in the Flemish population. *Language, Cognition and Neuroscience*, 37(2), 241–267.
- Feiken, J., Hüttmann, A., & Links, P. (2020). *Module specifieke therapie bij afasie, behandelmethodiek en diagnostiek*. Uitgeverij Koninklijke Van Gorcum, Assen.
- Forbes-McKay, K., Shanks, M.F., & Venneri, A. (2013). Profiling spontaneous speech decline in Alzheimer's disease: a longitudinal study. *Acta Neuropsychiatrica*, 25(06), 320-327.
- Joyal, M., Grouleau, C., Bouchard, C., Wilson, M.A., Fecteau, S., et al. (2020). Semantic processing in healthy aging and Alzheimer's Disease: a systematic review of the N400 differences. *Brain Sciences*, 10(11), 770.

Acknowledgments

This work is supported by the BOF Interdisciplinary Projects of Ghent University (grant number BOF/IOP/2022/112).

Figure 1. (a) N400 effect elicited during the related (blue) versus unrelated (orange) condition at electrode site P3, and (b) the corresponding topographical distribution in patient 2. Note: μV = microvolt.



The Curious Case of the Cat Rescue: Can Picture Narrative Description Inform Visuospatial Processing in Aphasia?

Sarah G. Dalton^{1*}, Javad Anjum¹, Davida Fromm², and Brian MacWhinney²

¹ Department of Communication Sciences and Special Education, University of Georgia, Athens, (Georgia), USA

² Department of Psychology, Carnegie Mellon University, Pittsburgh, (Pennsylvania), USA

*corresponding author, anjum@uga.edu

Introduction

Visuospatial and language processing are two distinct yet interconnected domains that are essential for human communication. Few studies have explored the interconnectedness of visuospatial processing and language abilities despite compelling evidence of their crucial involvement in communication functions in people with and without brain injuries, as well as those with hearing impairments (Diedrichs et al., 2022; Marini, 2012; Rudner et al., 2016). Given that people with aphasia (PWA) often present with co-occurring deficits in nonlinguistic cognitive domains, a discourse task such as picture description, which reflects everyday communication demands and their associated cognitive loads, offers a promising window into understanding the multifaceted connections between language production and visuospatial behavior (Dalton et al., 2020; Dalton et al., 2024). Specifically, Core Lexicon (CoreLex) analysis, which measures the typicality of words used in structured monologic discourse samples can be a valuable tool in this endeavor, as the success of lexical retrieval (measured by CoreLex) in picture description tasks can be influenced by visuospatial demands and an individual's ability to process various visual elements during language production. The analysis compares a person's lexical choice in a structured discourse task with a checklist that includes core words most commonly produced by people without brain injuries for the same task (Dalton et al., 2022; Fromm et al., 2024). Understanding these visuospatial patterns while engaged in a discourse production task (e.g., describing the *Cookie Theft* picture), can provide valuable insights into our understanding of visuospatial and language processing in PWA and their potential interrelationships. Our goal was to investigate group differences in the timing, order, and spatial location of core lexicon items produced by PWA and healthy control participants (HCP) while completing the *Cat Rescue* picture description task.

Methods

A total of 319 transcripts from HCP and 400 transcripts from PWA who completed the picture description task of the *Cat Rescue* were drawn from the AphasiaBank database (see Table 1). CoreLex scores and timing data of word production (the elapsed time to produce each core lexicon content item) were indexed using the CLAN (Computerized Language ANALysis) program. Survival analyses were completed to examine how many individuals in each group produced individual core lexicon words (e.g., the frequency of

production for the group) and the amount of time that elapsed between story start and core lexicon word production.

Results

The results of the one-way ANOVA revealed a significant effect of group on CoreLex production ($F[5,666] = 181.842$, $p < .001$, $\eta^2 = .577$), wherein HCP produced significantly more CoreLex items than PWA. Kaplan-Meier survival analyses demonstrated that HCP demonstrated a significantly shorter time to CoreLex word production compared to PWA. Despite consistency in the order of production across HCP and PWA, there were significant differences when comparing across aphasia severities (see Figure 1).

Conclusions

Study findings offer preliminary evidence for the clinical utility of integrating concurrent visuospatial processing and language production tasks as part of discourse assessment in PWA. Future implications for further expanding and refining discourse-based visuospatial processing assessment tools in aphasia rehabilitation are discussed.

References

- Dalton, S. G., Al Harbi, M., Berube, S., & Hubbard, H. I. (2024). Development of main concept and core lexicon checklists for the original and modern Cookie Theft stimuli. *Aphasiology*. Advance online publication. <https://doi.org/10.1080/02687038.2024.2340794>
- Dalton, S. G., Kim, H., Richardson, J. D., & Wright, H. H. (2020). A compendium of core lexicon checklists. *Seminars in Speech and Language*, 41(1), 45–60. <https://doi.org/10.1055/s-0039-3400972>
- Dalton, S. G., Stark, B. C., Fromm, D., Apple, K., MacWhinney, B., Rensch, A., & Rowedder, M. (2022). Validation of an automated procedure for calculating core lexicon from transcripts. *Journal of Speech, Language, and Hearing research*, 65(8), 2996–3003.
- Diedrichs, V. A., Jewell, C. C., & Harnish, S. M. (2022). A scoping review of the relationship between nonlinguistic cognitive factors and aphasia treatment response. *Topics in Language Disorders*, 42(3), 212–235. <https://doi.org/10.1097/TLD.0000000000000290>
- Fromm, D., Dalton, S. G., Brick, A., Olaiya, G., Hill, S., Greenhouse, J., & MacWhinney, B. (2024). The case of the cookie jar: Differences in typical language use in dementia. *Journal of Alzheimer's Disease*, 100(4), 1417–1434. <https://doi.org/10.3233/JAD-230844>
- Marini A. (2012). Characteristics of narrative discourse processing after damage to the right hemisphere. *Seminars in speech and language*, 33(1), 68–78. <https://doi.org/10.1055/s-0031-1301164>
- Rudner, M., Orfanidou, E., Cardin, V., Capek, C. M., Woll, B., & Rönnerberg, J. (2016). Preexisting semantic representation improves working memory performance in the visuospatial domain. *Memory & Cognition*, 44(4), 608–620. <https://doi.org/10.3758/s13421-016-0585-z>

Acknowledgments

The authors extend their gratitude to the participants whose data were included in this study, as well as to the researchers who collected and contributed the data to the AphasiaBank shared database.

Figure 1. Order of production of CoreLex words by group, based on the median time to produce each item. A larger vertical distance between the group label and the first CoreLex item reflects a longer time taken to produce that first item. Similarly, vertical distance between words indicates the relative timing of words, with larger distances indicating increased time between production of one CoreLex item and the next.

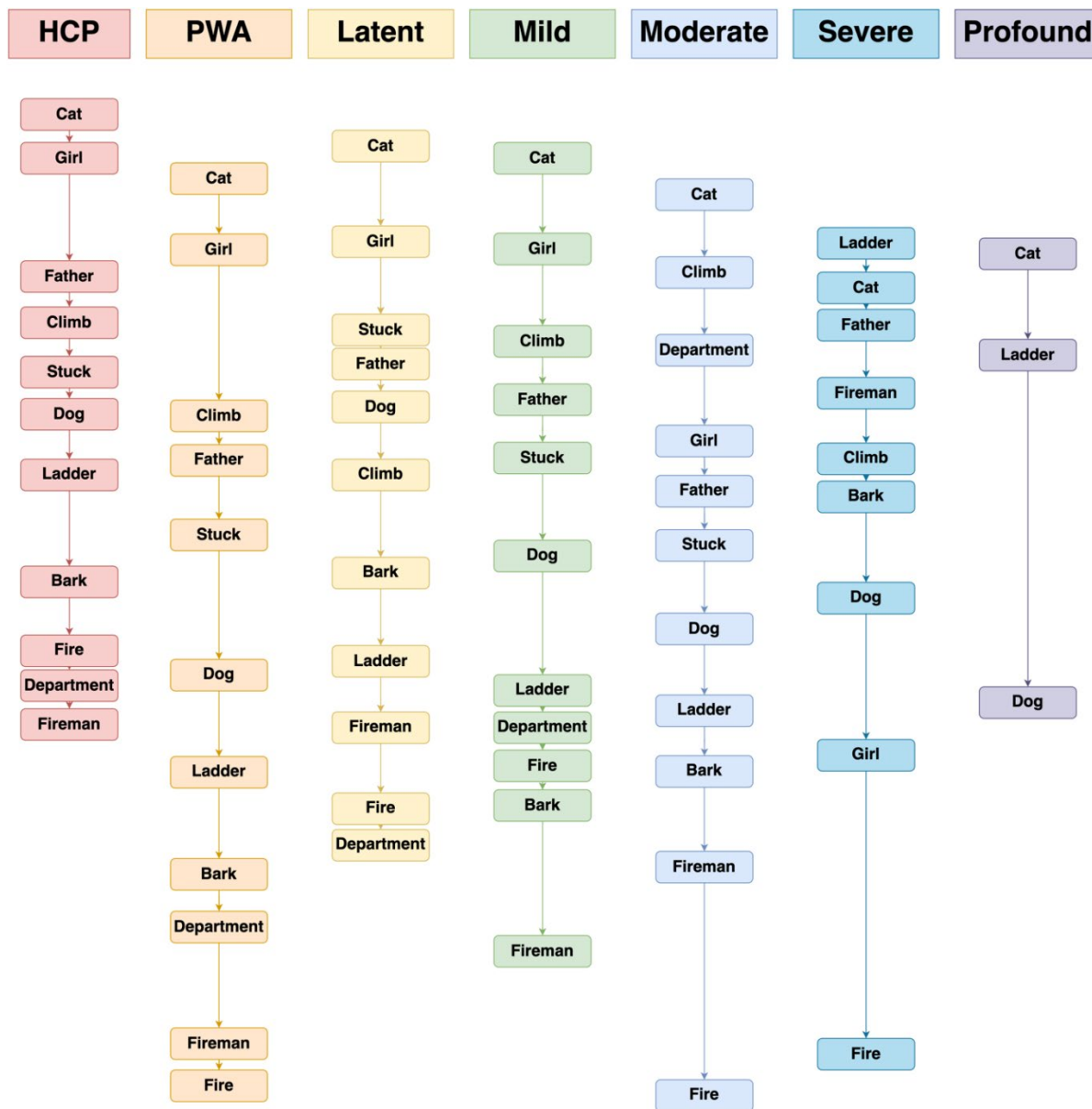


Table 1. Summary of participant demographic information across groups and by aphasia severity.

Participants	Age (yrs)			Education (yrs)			Sex		Race/Ethnicity								
	Mean (SD)	Range	MIS	Mean (SD)	Range	MIS	F	M	AA	AI	AS	HL	MIX	NH	OTH	WH	MIS
HCP (N = 299)	57 (21)	18-90	1	16 (2.7)	10-25	12	174	125	9	-	3	9		-	-	241	37
PWA* (N = 384)	61 (12)	25-91	2	16 (3)	7-25	17	154	230	39	1	5	6	4	2	2	310	15
Latent (N = 55)	59 (14)	25-80	-	17 (3.5)	10-24	2	32	23	3	-	1	2	1	1	1	40	6
Mild (N = 134)	62 (12)	31-86	1	16 (3)	12-25	5	50	84	9	-	2	2	-	-	1	115	5
Moderate (N = 130)	61 (12)	26-91	-	15 (3)	7-25	5	55	75	19	1	2	2	2	1	-	101	2
Severe (N = 44)	63 (13)	25-83	-	15 (3)	8-20	4	13	31	7	-	-	-	1	-	-	35	1
Profound (N = 10)	69 (9)	56-85	-	17 (3)	12-23	-	0	10	-	-	-	-	-	-	-	10	-

AA – African American; AI – American Indian; AS – Asian; F – Female; HL – Hispanic or Latino; M – Male; MIS – Missing; MIX – Mixed; NH – Native Hawaiian; OTH – Other; WH – White.

*This group includes 11 individuals who are missing aphasia severity data and are excluded from the severity sub-group analysis

Patterns of Pathological Language Mixing during Spontaneous Speech in Bilingual Aphasia

Celine Davis¹, Clarissa Salas¹, Kathleen-Linnea Poindexter², David Ajayi¹, Jael Azemard¹ and Gerald C. Imaezue^{1*}

¹ Department of Communication Sciences and Disorders, University of South Florida, Tampa, Florida, United States

²Department of Molecular Biosciences, University of South Florida, Tampa, Florida, United States

***Corresponding author:** Gerald C. Imaezue, Ph.D., gimaezue@usf.edu

Introduction

Bilingual aphasia, often caused by stroke, is a multimodal language impairment affecting speakers of two or more languages. While healthy bilinguals switch languages intentionally based on context (Walters, 2005), stroke can disrupt this language control, resulting in pathological language mixing (PLM)—involuntary switching that reflects impaired bilingual language regulation and hinders diagnosis and treatment (Auer, 2014). Although the Inhibitory Control Model (Green, 1998) provides explanations of neurocognitive underpinnings of PLM, the specific linguistic features implicated in PLM particularly during elicited spontaneous speech remain underexplored. The present study investigates how PLM during spontaneous speech interacts with word class, utterance length, and pause duration.

Methods

We recruited patient P3, a 59-year-old right-handed woman who was a premorbid bilingual, native-dominant in Spanish and acquired-dominant in English. P3 was diagnosed with severe Broca's aphasia and PLM using the Western Aphasia Battery-Revised (Kertesz, 2007) and Bilingual Switching Questionnaire (Rodriguez-Fornells et al., 2012), respectively. Spontaneous speech data was collected at two timepoints, one week apart. P3 used a smartphone and headphones at home to respond to 20 narrative prompts, initiating each one-minute response by pressing a "Record" button on the app. P3 was requested to respond only in English. Transcripts were primarily analyzed by author CD, who is a bilingual English-Spanish speaker and certified speech-language pathologist and author CS, who is also a bilingual English-Spanish speaker. We analyzed the data for the proportion of language mixing across open- and closed-class words and language mixing in relation to utterance length and pause durations before and after words. Pause durations were measured acoustically using Audacity in milliseconds before mixed and non-mixed words.

Results

Language Mixing and Word Class

Closed-class Spanish words were used more frequently ($M = 55.2$, $SD = 9.87$) than open-class words ($M = 35.78$, $SD = 10.62$) during language mixing (see Table 1). A Wilcoxon signed-rank test confirmed a statistically significant difference in the proportion of closed-class words versus open-class words across P3's responses ($Z = 4.713$, $p < .001$).

Furthermore, we observed that open-class cognates were used more frequently than closed-class cognates.

Language Mixing and Utterance Length

A non-significant positive correlation was found between utterance length and the frequency of language mixing ($r = 0.0420$, $p = 0.3559$), indicating that variation in utterance length did not reliably predict the frequency of language mixing (see Table 1).

Language mixing and pause durations

As shown in Figure 1 (Panel B), pause durations prior to language-mixed utterances were longer ($M = 880.20$ ms, $SD = 1180.20$) than those preceding non-mixed utterances ($M = 500.98$ ms, $SD = 675.30$).

Conclusions

Our findings suggest novel patterns of PLM in bilingual aphasia. Although closed-class words were more frequently involved in mixing, cognates appeared disproportionately among open-class words, suggesting a compensatory role. Our observation of longer latencies prior to PLM events provides a novel neurobehavioral window into the moment language control begins to fail. It reveals a potential temporal biomarker for PLM—capturing, in real time, the breakdown of bilingual language control.

References

- Auer, P. (2014). Language mixing and language fusion: when bilingual talk becomes monolingual. In J. Besters-Dilger, C. Dermarkar, S. Pfänder & A. Rabus (Ed.), *Congruence in Contact-Induced Language Change: Language Families, Typological Resemblance, and Perceived Similarity* (pp. 294-334). Berlin, Boston: De Gruyter.
- Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, 1(2), 67–81.
- Kertesz, A. (2007). *Western Aphasia Battery—Revised*. Pearson.
- Rodriguez-Fornells, A., Krämer, U. M., Lorenzo-Seva, U., Festman, J., & Münte, T. F. (2012). Self-assessment of individual differences in language switching. *Frontiers in Psychology*, 2, 388.
- Walters, Joel. (2005). Bilingualism: The sociopragmatic-psycholinguistic interface. *Bilingualism: The Sociopragmatic-Psycholinguistic Interface*. 1-323.

Acknowledgments

We wish to acknowledge our participant P3 and her spouse and our fellow lab members Gianna Mineo and Krishna Veni Maram.

Figure 1. Summary of language mixing patterns across lexical and temporal domains. Panel A displays the mean proportion of open- and closed-class Spanish words produced during language mixing. Panel B shows the average pause durations (in milliseconds) for utterances with and without language mixing. Error bars represent standard deviations. All data reflect P3's performance during baseline narrative samples.

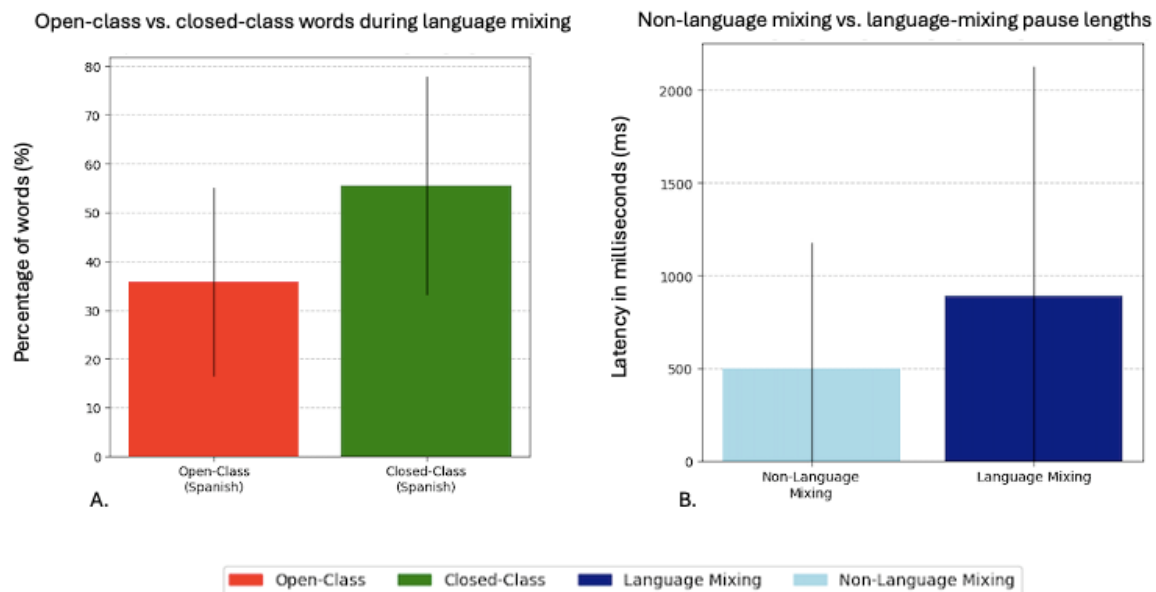


Table 1. Descriptive and Inferential Statistics on Language Mixing Patterns in P3.

Study Aims	Measure	Open-Class Words	Closed-Class Words	Test Statistic	p-value
Proportion of Word Class Usage in Spanish	Mean (%)	35.78	55.52	Z = 4.713	<.001
	SD	10.62	9.87		
	Spearman rho	-	-	0.04204	0.3559
Correlation Between Utterance Length and Language Mixing Frequency					
		Non-Language Mixing (in ms)	Language Mixing (in ms)	-	-
Pause duration and Language Mixing Frequency	Mean	500.98	880.20	-	-
	SD	675.30	1180.20	-	-

Functionally communicative picture naming accuracy in aphasia: Rethinking ability

Dirk B. den Ouden*, Laura Giglio, Sigfus Kristinsson, Sara Sayers, & Julius Fridriksson

Department of Communication Sciences and Disorders, University of South Carolina,
Columbia, South Carolina, United States

*corresponding author, denouden@sc.edu

Introduction

Most persons with aphasia (PWA) have some anomia, and naming accuracy is easy to score and quantify in terms of correctness and broad error categories. However, lexical accuracy does not necessarily reflect the full functional abilities of PWA, who may successfully use various verbal and nonverbal means to communicate meaning in daily life. We hypothesized that giving credit for functional-communicative accuracy would yield scores that better reflect aphasia severity, as well as major aphasia types and meaningful treatment outcomes.

Methods

107 PWA received intervention targeting word production.¹ The Philadelphia Naming Test (PNT²) was administered at baseline and five other times during and after treatment. We re-scored 77 participants' baseline and one-month post-treatment PNT responses, giving credit also for functionally correct responses, defined as "responses that could reasonably be expected to convey the intended lexical target to a naïve comprehender" either through an acceptable near-synonym/paronym, gesture, (air) spelling, or verbal description. In three separate analyses we (1) compared linear regression models predicting aphasia severity (WAB-R AQ³) based on original PNT scores (Org) versus based on the original plus added functional scores (Org_Func); (2) compared random-forest classification models of aphasia type (by WAB-R), based on the single original PNT score (Org) versus based on four additional scoring categories – Verbal, Gesture, Spelling, and Description (Func); and (3) compared treatment response from baseline to one-month post treatment, based on Org versus Org_Func scores.

Results

Comparison of two linear regression models predicting WAB-R AQ showed that the Org_Func model provides a considerably better fit than the Org model (Figure 1). The AIC difference of 5.56 yields a relative likelihood ratio of 16.1, favoring the 'functional' model to minimize information loss over the 'original model'. The Akaike weight confirms this interpretation: there is approximately a 94.2% probability that the 'functional' model is superior (in terms of expected predictive accuracy), compared to only 5.8% for the 'original' model. Random-forest classification of aphasia types shows that, although the Func model yields numerically higher accuracy (+0.07) and Kappa values (+0.09), adding the extra functional scores does not lead to a statistically significant improvement in model performance (neither in accuracy nor Kappa). Finally, a linear mixed-effects regression

predicting accuracy based on the original versus functional scoring criteria, and between baseline and one-month post treatment, shows that scores are independently higher with functional coding (a mathematical necessity; estimate 7.77; $p < .001$) and after treatment (estimate 6.42; $p < .001$), but without an added benefit (interaction estimate = -0.23, *ns*).

Conclusions

Re-coded PNT scores based on functional accuracy may provide a better reflection of a PWA's actual ability and severity, although no strong improvements were noted for aphasia classification, nor as treatment outcome measures. Critically, these naming data were obtained with the original PNT instructions, which do not ask the participants to use their full communicative arsenal to convey meaning, but instead only target lexical accuracy. Given the correlation with aphasia severity even without modified task instructions, we argue it is worth pursuing this approach to providing a quantification of functional-communicative ability in PWA.

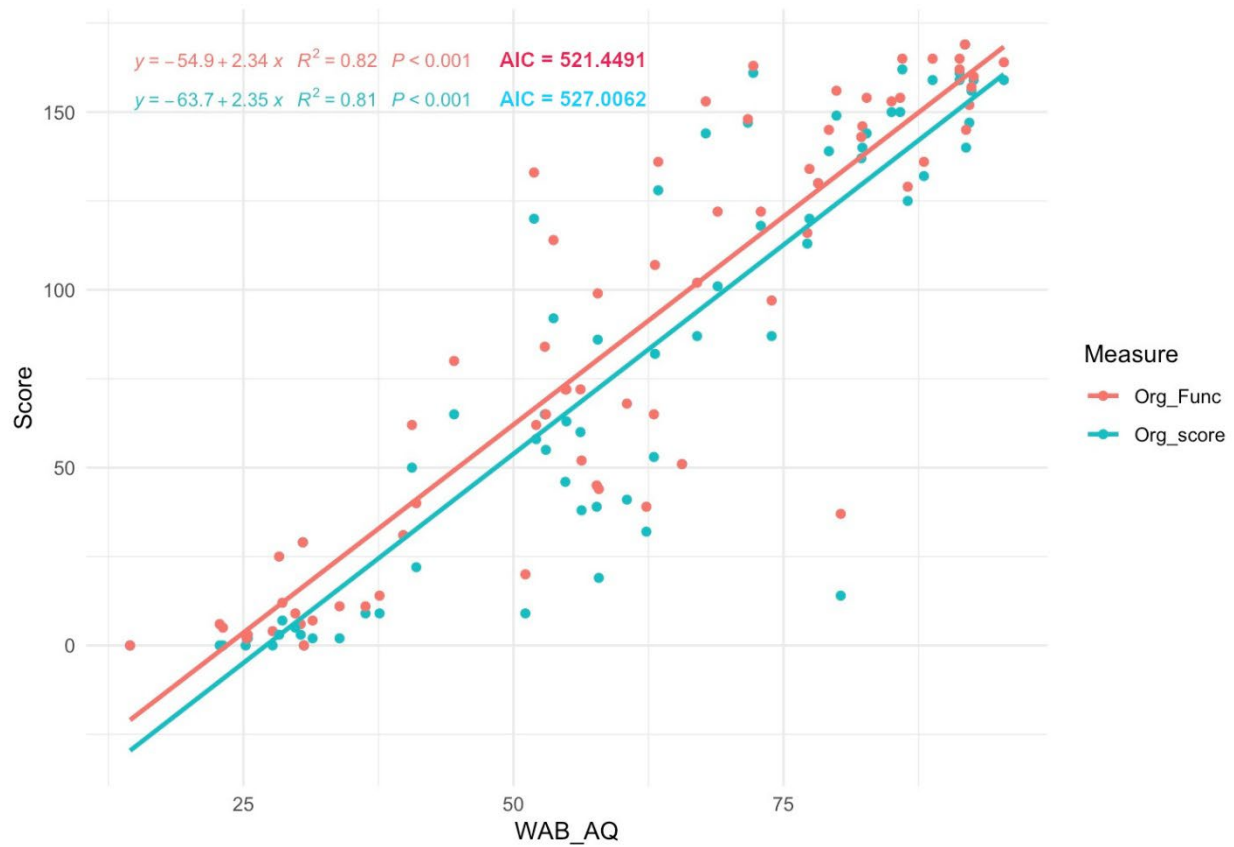
References

- Kristinsson, S., Basilakos, A., den Ouden, D. B., Cassarly, C., Spell, L. A., Bonilha, L., Rorden, C., Hillis, A. E., Hickok, G., Johnson, L., Busby, N., Walker, G. M., McLain, A., & Fridriksson, J. (2023). Predicting Outcomes of Language Rehabilitation: Prognostic Factors for Immediate and Long-Term Outcomes After Aphasia Therapy. *J Speech Lang Hear Res*, 66(3), 1068-1084.
- Roach, A., Schwartz, M. F., Martin, N., Grewal, R. S., & Brecher, A. (1996). The Philadelphia Naming Test: Scoring and Rationale. *Clinical aphasiology*, 24, 121-133.
- Kertesz, A. (2007). *Western Aphasia Battery - Revised*. San Antonio, TX.: Pearson.

Acknowledgements

This study was supported by the National Institutes of Health / National Institute on Deafness and Other Communication Disorders: P50 DC014664 (PI: Fridriksson).

Figure 1. Correlations between (1) original (lexically correct) PNT scores and WAB-R AQ (blue) and (2) functionally correct PNT responses and WAB-R AQ (red).



Exploring the Effects of a Group Aphasia Treatment on the Use of Co-Speech Gestures

Suma R. Devanga^{1*} and Mili Mathew²

¹Department of Communication Disorders and Sciences, RUSH University Medical Center, Chicago, IL, USA

²Department of Communication Sciences and Disorders, Molloy University, Rockville Centre, NY, USA

*corresponding author, suma_devanga@rush.edu

Introduction

Group-based treatments for aphasia have garnered growing attention for their potential to promote the generalization of language skills to real-world communication, enhance life participation, and provide cost-effective rehabilitation (Bollinger et al., 1993; Elman & Bernstein-Ellis, 1999; Elman, 2007). These interventions typically involve small groups of individuals with aphasia (IWA) participating in conversation-driven activities led by a speech-language pathologist (SLP). The collaborative and socially enriched nature of these settings encourages peer modeling, shared communicative strategies, and interactive learning. Building on this foundation, the present exploratory study investigated a novel group-based Collaborative Referencing Intervention (CRI) (Devanga, 2023; Hengst et al., 2010) and its impact on the use of co-speech hand gestures during group conversations in individuals with chronic aphasia.

Methods

This study utilized a mixed methods design, incorporating both qualitative and quantitative analysis of measures. Three adults with chronic aphasia (Fred, 80/M, moderate Conduction aphasia; Dutch, 80/M, Moderate Conduction aphasia; and Kris, 80/F, Mild Anomic aphasia) participated in the study. The research protocol included a pre-treatment group conversation (60 minutes), ten Group CRI sessions, and a post-treatment group conversation (60 minutes). All conversations were video-recorded, transcribed, and analyzed. Each Group CRI session comprised four structured trials involving a director-matcher format. In each trial, one participant described the layout of 12 images placed on a numbered board behind a physical barrier, while the others attempted to replicate the arrangement. Across all sessions, 60 unique images related to personally relevant topics (e.g., places, hobbies, events) were used.

Gesture analysis was conducted using ELAN software. Co-speech gestures were identified and categorized based on frameworks by McNeill and Levy (1982) and Holler (2010). Gesture types included Referential Gestures—such as Iconic Entity, Iconic Action, Metaphoric, and Deictic—and Non-Referential Gestures, primarily Beats. Two trained coders independently annotated gesture instances across the pre- and post-treatment conversation samples, followed by a consensus coding pass to ensure accuracy and reliability.

Results

Overall, there was individual variability in gesture frequency, but the total number of gestures produced by the group remained consistent from pre-treatment (n = 517) to post-treatment (n = 508). However, referential gestures (n = 692) were observed more than twice as often as non-referential gestures (n = 333) across both conversation samples. Notably, there was a shift in gesture type between pre- and post-treatment: the frequency of referential gestures decreased, while non-referential gesture use increased in each participant (see Figure 1). This shift may reflect improved communicative efficiency as they are moving away from semantically related gestures to ones that are prosodically aligned. This could be due to gains in shared understanding facilitated by the group-CRI.

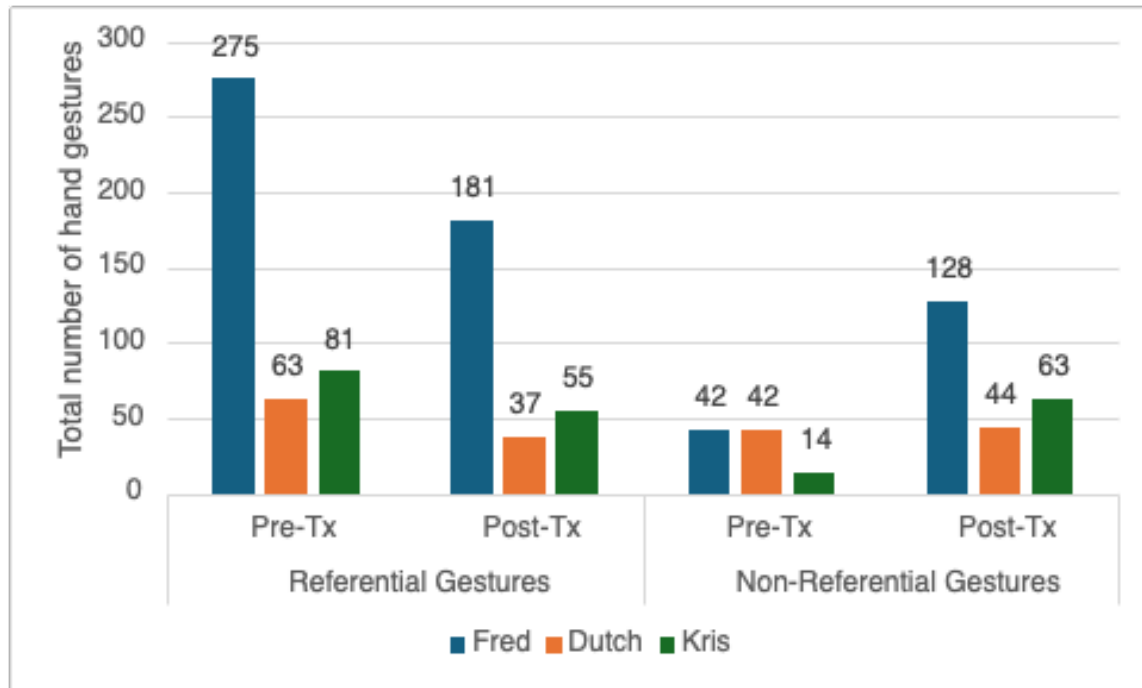
Conclusion

These preliminary findings suggest that co-speech hand gestures, particularly changes in gesture type, may serve as promising outcome measures for evaluating aphasia interventions. Further research with larger samples and additional linguistic measures is warranted to explore the broader treatment effects of Group CRI and the clinical significance of gestural changes in aphasia rehabilitation.

References

- Bollinger, R., Musson, N., & Holland, A. (1993). A study of group communication intervention with chronically aphasic persons. *Aphasiology*, 7(3), 301–313.
- Davis, G.A. (2014). *Aphasia and related cognitive-communication disorders*. Boston: Pearson.
- Devanga, S. R. (2023). Referential Learning in Aphasia: Phase-I Treatment Research on Group Collaborative Referencing Intervention (G-CRI). Poster presentation at the ASHA (American Speech Language and Hearing Association) Annual Convention at Boston, MA: November 16-18, 2023.
- Elman, R. J., & Bernstein-Ellis, E. (1999). The efficacy of group communication treatment in adults with chronic aphasia. *Journal of Speech, Language, and Hearing Research*, 42, 411–419. <http://doi.org/10.1044/jslhr.4202.411>
- Hengst, J. A., Duff, M. C., & Dettmer, A. (2010). Rethinking repetition in therapy: Repeated engagement as the social ground of learning. *Aphasiology*, 24(6–8), 887–901.
- Holler, J. (2010). Speakers' use of interactive gestures to mark common ground. In S. Kopp, & I. Wachsmuth (Eds.). *Gesture in embodied communication and human-computer interaction*. 8th International Gesture Workshop, Bielefeld, Germany, 2009; Selected Revised Papers (pp. 11–22). Springer Verlag.
- McNeill, D., & Levy, E. (1982). Conceptual representations in language activity and gesture. In R. Jarvella & W. Klein (Eds.). *Speech, place, and action: Studies in deixis and related topics* (pp. 271-295). Wiley.

Figure 1. Total Referential and Non-Referential Gestures produced by the three IwA during Pre- and Post-Treatment Conversations.



Meta-analysis of VNeST effect sizes: Magnitudes and predictors of treatment benefits

Michael Walsh Dickey^{1,2*}, Vanessa Nolan¹, and Julia Shellard¹

¹ Department of Communication Sciences & Disorders, University of Pittsburgh,
Pittsburgh, PA, USA

² Geriatric Research Education and Clinical Center, VA Pittsburgh Healthcare System,
Pittsburgh, PA, USA

***corresponding author, mdickey@pitt.edu**

Introduction

Verb Network Strengthening Treatment (VNeST: Edmonds, 2016) is a semantically-oriented treatment that is commonly used to improve word and sentence production in aphasia (Raymer & Roitsch, 2023). However, evidence for its efficacy to date has come from single-subject design studies. The current study used effect-size meta-analysis to provide group-level evidence for benefits of VNeST, to address the following research questions:

RQ1: What is the magnitude of VNeST treatment benefits (Beeson & Robey, 2006)?

RQ2: Does VNeST engender greater benefits for treated than untreated related stimuli (Wisenburn & Maoney, 2009)?

RQ3: What person-level factors predict variation in VNeST-related benefits (Johnson et al., 2022)?

Methods

VNeST treatment studies were identified based on review papers (Edmonds, 2016; Hickin et al., 2022). PubMed and Google Scholar searches targeting “Verb Network Strengthening Treatment” and “VNeST” identified additional published and unpublished studies. All studies reporting participant-level effect-size data for treated and untreated stimuli were selected for analysis. Effect-size data were extracted by two independent coders, with discrepancies resolved by a third coder. Descriptive statistics were used to determine the magnitude of VNeST benefits (RQ1). Linear mixed-effect regression analyses were used to determine whether benefits were greater for treated than untreated stimuli (RQ2), and to examine which person-level traits (education, age, months post-onset [MPO], sex, and aphasia severity) predicted VNeST-related benefits (RQ3).

Results

We located 28 VNeST treatment studies. Of these, 8 studies reported effect-size data for 25 unique participants with aphasia (Table 1A). Post-treatment and follow-up effect-size data were available for 24 and 17 participants, respectively. There was wide variation in VNeST’s benefits (Table 1B), with small-to-medium effect sizes immediately post-treatment and small effect sizes at follow up for treated stimuli (Beeson & Robey, 2006).

Untreated stimuli showed small effect sizes at both timepoints. There were larger gains for treated than untreated stimuli immediately post-treatment ($\beta=3.84$, $p<.02$), but not at follow-up ($\beta=0.81$, $p>.24$). There were marginal main effects of aphasia severity (Kertesz, 2006) ($\beta=-0.14$, $p<.07$) and MPO ($\beta=-0.03$, $p<.09$) on post-treatment effect sizes only: more severe aphasia and fewer months post-onset were associated with larger effect sizes. However, neither factor interacted with the treated/untreated difference.

Conclusions

These findings provide group-level evidence of VNeST's benefits for both treated and untreated stimuli. Benefits were greater for treated stimuli (Wisenburn & Mahoney, 2009), were more robust immediately post-treatment, and varied widely across individuals. Two person-level factors appeared predictive of VNeST's benefits: aphasia severity and time post-onset, with greater gains for more-severe participants and those closer to time of stroke (Johnson et al., 2022; Watila & Balarabe, 2015). However, there was no evidence that aphasia severity moderated the degree of improvement for treated vs. untreated stimuli. This finding is in contrast to other semantically-oriented aphasia treatments focused on word retrieval (Quique et al., 2018; Sandberg et al., 2023). For these treatments, milder aphasia is associated with a smaller difference between treated and untreated stimuli, suggesting greater generalization to untreated stimuli. This finding suggests that VNeST may engage different representations and mechanisms from word-level semantically-oriented treatments (McRae & Matsuki, 2009).

References

- Beeson, P. M., & Robey, R. R. (2006). Evaluating single-subject treatment research: Lessons learned from the aphasia literature. *Neuropsychology Review*, 16(4), 161–169.
- Brophy, E. (2016). *Generalization across verb types after Verb Network Strengthening Treatment (VNeST): A treatment study*. Master's thesis, Temple University.
- Edmonds, L. A. (2016). A Review of Verb Network Strengthening Treatment: Theory, Methods, Results, and Clinical Implications. *Topics in Language Disorders*, 36(2), 123–135.
- Edmonds, L. A., & Babb, M. (2011). Effect of Verb Network Strengthening Treatment in Moderate-to-Severe Aphasia. *American Journal of Speech-Language Pathology*, 20(2), 131.
- Edmonds, L. A., Mammino, K., & Ojeda, J. (2014). Effect of Verb Network Strengthening Treatment (VNeST) in persons with aphasia: Extension and replication of previous findings. *American Journal of Speech-Language Pathology*, 23(2), S312–S329.
- Furnas, D. W., & Edmonds, L. A. (2014). The effect of computerised Verb Network Strengthening Treatment on lexical retrieval in aphasia. *Aphasiology*, 28(4), 401–420.
- Hickin, J., Cruice, M., & Dipper, L. (2022). A Systematically Conducted Scoping Review of the Evidence and Fidelity of Treatments for Verb and Sentence Deficits in Aphasia: Sentence Treatments. *American Journal of Speech-Language Pathology*, 31(1), 431–462.

- Johnson, L., Nemati, S., Bonilha, L., Rorden, C., Busby, N., Basilakos, A., Newman-Norlund, R., Hillis, A. E., Hickok, G., & Fridriksson, J. (2022). Predictors beyond the lesion: Health and demographic factors associated with aphasia severity. *Cortex*, 154, 375–389.
- Kertesz, A. (2006). *Western Aphasia Battery—Revised*. Pearson Assessment.
- Kim, S. E., La, E. Y., & Sung, J. E. (2022). Effects of Verb Network Strengthening Treatment (VNeST) using Telepractice on Word Retrieval in Korean-Speakers with Non-Fluent Aphasia. *Communication Sciences & Disorders*, 27(3), 629–646.
- Kwag, E. J., Sung, J. E., Kim, Y.-H., Cheond, H.-J., Kwag, E. J., Sung, J. E., Kim, Y.-H., & Cheond, H.-J. (2014). Effects of verb network strengthening treatment on retrieval of verbs and nouns in persons with aphasia. *Communication Sciences & Disorders*, 19(1), 89–98.
- McRae, K., & Matsuki, K. (2009). People use their knowledge of common events to understand language, and do so as quickly as possible. *Language and Linguistics Compass*, 3(6), 1417–1429.
- Parkes, B. (2017). *Is Verb Network Strengthening Treatment (VNeST) Effective at a Lower Dosage?* Master's thesis, Temple University.
- Raymer, A. M., & Roitsch, J. (2023). Word Retrieval Treatments in Aphasia: A Survey of Professional Practice. *Aphasiology*, 37(7), 954–979.
- Torinsson, M., Saldert, Charlotta, Rödseth Smith, Signe, Kristensson, Joana, & Longoni, F. (2024). Telerehabilitation with Verb Network Strengthening Treatment (VNeST) in two participants with mild-to-moderate and moderate-to-severe aphasia: A single-case experimental design study. *Aphasiology*, 38(10), 1644–1667.
- Watila, M., & Balarabe, S. (2015). Factors predicting post-stroke aphasia recovery. *Journal of the Neurological Sciences*, 352(1), 12–18.
- Wisernburn, B., & Mahoney, K. (2009). A meta-analysis of word-finding treatments for aphasia. *Aphasiology*, 23(11), 1338–1352.

Acknowledgments

The authors are grateful to colleagues in the Language and Brain Laboratory at the University of Pittsburgh, the VA Aphasia Lab at VA Pittsburgh Healthcare System, and Dr. Yina Quique of the University of New Mexico for comments and input. It was supported in part by resources of the Geriatric Research Educational and Clinical Center of VA Pittsburgh Healthcare System.

Table 1A-B: VNeST studies included (1A) and VNeST study effect sizes (1B)

Table 1A: VNeST studies included in analysis		
Study	Language	Number of Participants
Edmonds et al., (2014)	English	11
Parkes (2017)	English	1
Brophy (2016)	English	1
Edmonds & Babb (2011)	English	2
Furnas & Edmonds (2014)	English	2
Torinsson et al. (2024)	Swedish	2
Kim et al. (2022)	Korean	3
Kwag et al. (2014)	Korean	3

Table 1B: Effect sizes for included VNeST studies				
	Mean	Minimum	Maximum	SD
<u>Post-treatment</u>	5.86	-0.45	38.60	6.66
Treated	7.78	0.18	38.60	8.43
Untreated	3.94	-0.45	12.12	3.46
<u>Follow-Up</u>	2.94	-1.22	9.39	2.27
Treated	3.32	-1.10	6.22	2.09
Untreated	2.55	-1.22	9.39	2.45

Breaking Barriers: Challenges in Communication Partner Training and Ongoing AAC Use in Post-Stroke Aphasia

Chloe Domingues^{1*} & Peabody Smith²

¹College of Arts and Sciences, Lehigh University, Bethlehem, (Pennsylvania), United States

²College of Health, Lehigh University, Bethlehem, (Pennsylvania), United States

***corresponding author, chd421@lehigh.edu**

Introduction

This research presents the preliminary outcomes of a qualitative study exploring barriers to Communication Partner Training (CPT) and the ongoing use of Augmentative and Alternative Communication (AAC) devices in individuals with post-stroke aphasia. A key factor to the success of AAC devices is the involvement of family members and other communication partners (Coburn et al., 2021). Further, communication partner training on AAC device use is essential to the rehabilitation process, as effectiveness requires not only training for the individual with aphasia, but also device education for those who will be their primary communication supporters. Despite the evidence supporting AAC use and family involvement, there remains a disconnect between family involvement and the ongoing use of these devices among individuals with aphasia. Existing literature shows the perspective of speech therapists on the barriers to CPT (Shrubsole et al., 2023), but little has been shown from the communication partners perspective (Hanley et al., 2022). It is vital that the communication partners that are directly impacted by these healthcare decisions are involved in the conversation about way to improve the rehabilitation process.

Methods

This research will be performed through collaboration with Good Shepherd Rehabilitation, a non-profit medical organization that centralizes work with survivors of stroke, traumatic brain injury, and other communication disorders or disabilities. We are scheduled to begin interviews in May, with analysis occurring over the summer. Interviews of communication partners will be conducted using a semi-structured interview guide. To focus on the barriers for these partners, the discussion will revolve around the individual with post stroke aphasia, the type of AAC device used, way of affording the device, if CPT was offered and/or completed, and the factors that contributed to the choice of participating in CPT. This will allow communication partners to share their experiences in a way that research focused on other healthcare providers does not.

Results

With interviews and analysis occurring over the summer of 2025, preliminary findings will be available well ahead of the Academy of Aphasia conference in October 2025. Anticipated results point to three general themes of limitations as found in previous literature: environmental, financial, and educational (Shrubsole et al. 2023; Uthoff et al.

2021). Once interviews are conducted, thematic analysis will occur to find reoccurring themes using an inductive approach.

Conclusions

Discussion of this research and its reoccurring central themes can help provide healthcare providers with perspectives that will encourage education of CPT and AAC devices to better help their clients. We believe that this interdisciplinary research will make a valuable contribution to the Academy of Aphasia Convention as it brings together ideas of health care access, family involvement, and therapy practices that will be invaluable to the Aphasia community.

References

- Coburn, K. L., Jung, S., Ousley, C. L., Sowers, D. J., Wendelken, M., & Wilkinson, K. M. (2021). Centering the family in their system: A framework to promote family-centered AAC services. *Augmentative and Alternative Communication*, 37(4), 229–240. <https://doi.org/10.1080/07434618.2021.1991471>
- Hanley, E., Martin, A.-M., Dalton, C., & Lehane, E. (2023). Communication partners experiences of communicating with adults with severe/profound intellectual disability through augmentative and alternative communication: A mixed methods systematic review. *Journal of Intellectual Disabilities*, 27(4), 1107–1134. <https://doi.org/10.1177/17446295221115914>
- Shrubsole, K., Power, E., & Hallé, M. (2023). Communication partner training with familiar partners of people with aphasia: A systematic review and synthesis of barriers and facilitators to implementation. *International Journal of Language & Communication Disorders*, 58(2), 601–628. <https://doi.org/10.1111/1460-6984.12805>
- Uthoff, S. A. K., Zinkevich, A., Boenisch, J., Sachse, S. K., Bernasconi, T., & Ansmann, L. (2021). Collaboration between stakeholders involved in augmentative and alternative communication (AAC) care of people without natural speech. *Journal of Interprofessional Care*, 35(6), 821–831. <https://doi.org/10.1080/13561820.2020.1860918>

Sound symbolism across multiple domains of meaning for people with aphasia

Josh Dorsi^{1*}, Chaleece W. Sandberg², Simon Lacey^{1,3,4}, Lynne Nygaard⁵, and Krish Sathian^{1,3,4}

¹ Department of Neurology, Penn State College of Medicine, Hershey, (PA), USA

² Department of Communication Sciences and Disorders, Penn State College of Health and Human Development, University Park, (PA), USA

³ Department of Neuroscience & Experimental Therapeutics and Psychology, Penn State College of Medicine, Hershey, (PA), USA

⁴ Department of Psychology, Penn State College of Liberal Arts, University Park, (PA), USA

⁵ Department of Psychology, Emory University, Atlanta, (GA), USA

*corresponding author, JoshDorsi@psu.edu

Introduction

Sound symbolism is a phenomenon in which speech sounds convey certain types of ideas. For example, people typically associate the pseudoword ‘bouba’ with a rounded shape but the pseudoword ‘kiki’ with a pointed shape. Sound symbolism is relevant to many domains of meaning, for example, in addition to rounded/pointed, speech stimuli can sound big/small, exciting/calming, good/bad, etc. (Sidhu et al., 2022). The sound-meaning link suggested by sound symbolism could be a useful tool for improving word finding in people with aphasia. Unfortunately, with only two published reports, the relationship between sound symbolism and aphasia is still poorly understood. Ammon et al. (1977) found that people with aphasia were less systematic than neurologically intact people when associating pseudowords with images, suggesting that aphasia might weaken sound-symbolic mappings. However, it is unclear what domain of meaning was tested by this work. More recently, Meteyard et al. (2015) found that onomatopoeic words were easier for people with aphasia to process across a range of tasks relying on phonological-to-semantic mappings. Thus, sound symbolism appears to be preserved in people with aphasia, in at least some domains of meaning. The present work expands this limited research by systematically testing for sound symbolism in people with aphasia across four domains of meaning: shape (rounded/pointed), size (big/small), valence (good/bad), and arousal (calming/exciting).

Methods

Ten participants with aphasia (5 with Broca’s aphasia, 5 with anomic aphasia) participated in this experiment. Ten age- and gender-matched neurologically intact controls also participated (see Table 1). Sound symbolism was assessed with a series of two-alternative forced-choice tasks (2AFCs) asking participants to classify which domain endpoint (e.g. rounded or pointed) auditory pseudowords sounded like. Each domain of meaning was tested in a separate 2AFC, and each 2AFC consisted of 40 consonant-vowel-consonant-vowel pseudowords determined by prior testing to be strongly associated with each domain endpoint.

Results

Accuracy for each group and domain is shown in Figure 1. A 2 (Group) X 4 (Domain) analysis of variance indicates that there were reliable effects of group ($p < .01$) and domain ($p < .01$), but no interaction ($p > .1$). One sample t-tests indicated that the neurologically intact people performed above chance for all domains ($p < .01$). However, the people with aphasia had above-chance accuracy for the shape and arousal domains ($p < .01$), but not for the size and valence domains ($p > 0.05$).

Conclusions

The key finding from the present data is that people with aphasia perform above chance on sound-symbolic judgments for multiple meaning domains. This indicates that sound symbolism is at least partly intact in people with aphasia. This result is consistent with Meteyard et al. (2015), but expands on that prior work by testing multiple domains and testing cross-modal (as opposed to within-modal, onomatopoeic) mappings. These results suggest that sound symbolism, for some domains of meaning, might be viable as a tool for improving word finding in people with aphasia. Future work will test additional domains, real words, and the relationship between aphasia type and sound symbolism.

References

- Ammon, K. H., Moerman, C., & Guleac, J. D. (1977). Aphasics' defective perception of connotative meaning of verbal items which have no denotative meaning. *Cortex*, *Cortex*(13), 453–457.
- Meteyard, L., Stoppard, E., Snudden, D., Cappa, S. F., & Vigliocco, G. (2015). When semantics aids phonology: A processing advantage for iconic word forms in aphasia. *Neuropsychologia*, *76*, 264–275.
- Sidhu, D. M., Vigliocco, G., & Pexman, P. M. (2022). Higher order factors of sound symbolism. *Journal of Memory and Language*, *125*(February), 104323.

Acknowledgments

This work was supported by institutional funds from The Pennsylvania State University

Figure 1. Accuracy for sound-symbolic judgments on each domain of meaning

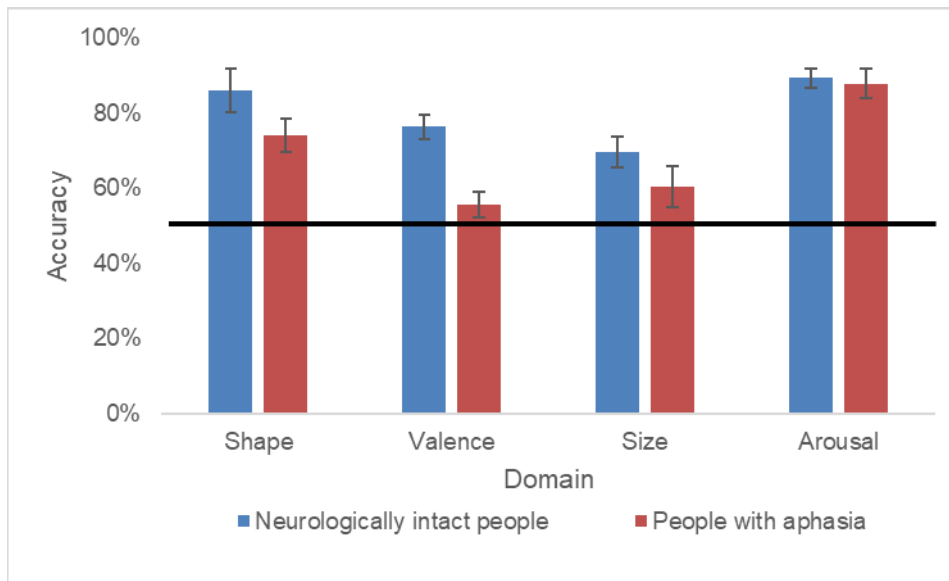


Table 1. Participants

		Neurologically intact people	People with aphasia
Age M (SEM)	Male	47 (7)	47 (5)
	Female	65 (3)	64 (2)

Neural predictors of event knowledge access in individuals with aphasia

Haley C. Dresang^{1*}, Abel Lei², Tessa Warren³, and Michael Walsh Dickey^{2,4}

¹ Department of Communication Sciences & Disorders, University of Wisconsin–Madison, Madison, WI, USA

² Department of Communication Sciences & Disorders, University of Pittsburgh, Pittsburgh, PA, USA

³ Department of Psychology, University of Pittsburgh, Pittsburgh, PA, USA

⁴ Geriatric Research Education and Clinical Center, VA Pittsburgh Healthcare System, Pittsburgh, PA, USA

***corresponding author, hdresang@wisc.edu**

Introduction

The Event Task measures access to generalized events stored in semantic memory. It has been examined in a normative sample and in adults with aphasia, where event performance was associated with language abilities such as verb naming and function assignment (Dresang, Dickey, & Warren, 2019). Prior studies have proposed that embodied representations in motor-related cortices support event comprehension (Lei et al., 2016), while others emphasize higher-order association areas (Binder & Desai, 2011). To clarify the neural basis of individual differences in event knowledge access, we examined lesion-based neural predictors of performance. Elucidating the neural mechanisms required for event semantics may facilitate identification of candidates for aphasia treatments that rely upon event knowledge (Verb Network Strengthening Treatment; Edmonds, 2016).

Methods

Eighteen adults with chronic stroke aphasia completed the Event Task (256 items). Lesions were manually traced on T1-weighted MRI and validated by neurologists. For each participant, proportion of lesion damage per region of interest (ROI) was calculated using the AAL atlas in MRICron. ROIs with <10% lesion overlap across participants were excluded, yielding 12 ROIs for analysis. We applied lasso regression to identify non-zero predictors of trial-level Event Task accuracy, followed by nonparametric bootstrapping ($R = 1000$) to estimate the coefficient distributions and standard errors. We conducted permutation-based stability selection to assess the robustness of ROI predictor contributions. This approach increases confidence in variable selection despite the modest sample size.

Results

Event Task accuracy was $M=0.869$, $SD=0.097$. Several ROIs showed non-zero average coefficients with consistent directionality associated with Event performance. Of the ROIs with moderate stability (none surpassed 95% confidence), bootstrap coefficients highlighted positive associations with left precentral gyrus (68.3%), middle frontal gyrus (85.3%), inferior frontal gyrus pars triangularis (72.1%), and supramarginal gyrus (76.7%),

as well as negative associations with left postcentral gyrus (74.0%) and inferior frontal gyrus pars orbitalis (79.5%). See Figure 1 for coefficients, standard error, and stability per ROI.

Conclusions

Findings suggest that both association regions (MFG, SMG) and sensorimotor areas (pre/postcentral) contribute to event knowledge access. While there is debate regarding the role of embodied motor representations versus higher-order association areas (Binder & Desai, 2011; Lei et al., 2016), these results indicate co-engagement of distributed networks that include both primary and association regions, consistent with Fernandino et al. (2022). Trends suggest that less damage to regions like the postcentral gyrus and pars orbitalis is associated with better event knowledge access, highlighting their potential role in supporting performance. In contrast, greater lesion burden in the precentral gyrus, middle frontal gyrus, pars triangularis, and supramarginal gyrus was linked to better accuracy, reflecting potential compensatory reorganization. Overall, these patterns indicate that preservation of certain sensorimotor and semantic integration regions may support event cognition, with some lesion patterns possibly unmasking more effective alternative pathways. There appears to be a shift in coefficient directionality between adjacent regions of both primary and association cortices, which may reflect a shift in function across a distributed semantic network. This preliminary evidence underscores the complexity of post-stroke cognitive organization and warrants confirmation in larger samples.

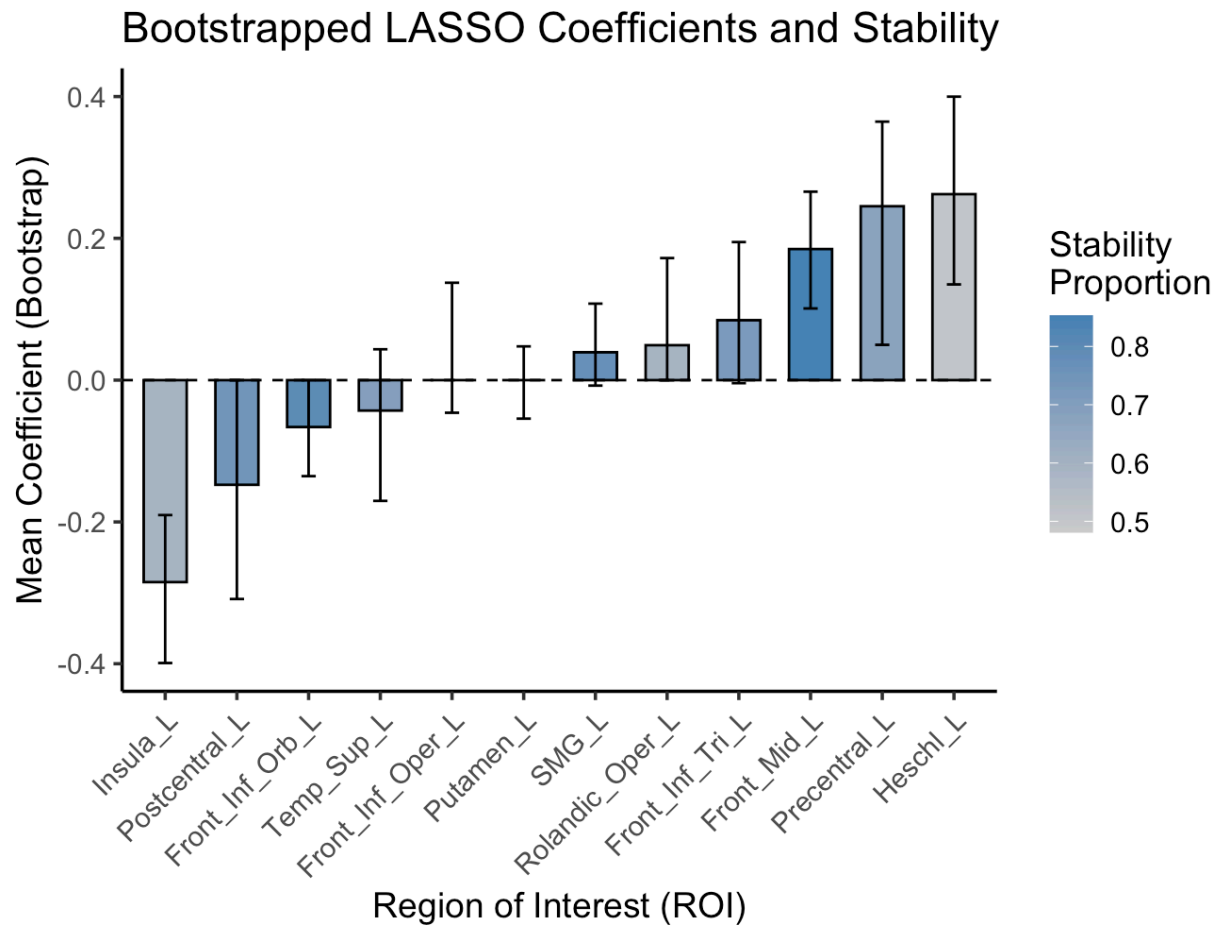
References

- Binder, J. R., & Desai, R. H. (2011). The neurobiology of semantic memory. *Trends in Cognitive Sciences*, 15(11), 527–536.
- Dresang, H. C., Dickey, M. W., & Warren, T. (2019). Semantic memory for objects and events: A novel test of event-related conceptual semantic knowledge. *Cognitive Neuropsychology*, 36(7-8), 313–335.
- Edmonds, L. A. (2016). A Review of Verb Network Strengthening Treatment: Theory, Methods, Results, and Clinical Implications. *Topics in Language Disorders*, 36(2), 123–135.
- Fernandino, L., Tong, J.-Q., Conant, L. L., Humphries, C. J., & Binder, J. R. (2022). Decoding the information structure underlying the neural representation of concepts. *Proceedings of the National Academy of Sciences*, 119(6), e2108091119.
- Lei, C.-M., Dresang, H. C., Holcomb, M. B., Warren, T. C., & Dickey, M. W. (2016). Neural bases of semantic-memory deficits for events. Proceedings of the 2016 Cognitive Science Society.

Acknowledgments

The authors are grateful to the Language and Brain Lab, Rand Williamson, and Felipe Rosero Castro for experimental support. This work was supported by award R01 DC011520 to the last two authors.

Figure 1. Bootstrapped LASSO Coefficients and Stability.



Notes: LASSO = Least Absolute Shrinkage and Selection Operator. L = left hemisphere. Frontal_Inf_Orb = inferior frontal gyrus pars orbitalis. Temp_Sup = superior temporal gyrus. Frontal_Inf_Oper = inferior frontal gyrus pars opercularis. SMG = supramarginal gyrus. Frontal_Inf_Tri = inferior frontal gyrus pars triangularis. Front_Mid = middle frontal gyrus.

Cognitive and Expository Discourse Abilities in Individuals with Mild Aphasia

Manaswita Dutta^{1*} and Hana Kim²

¹ Department of Speech and Hearing Sciences, Portland State University, Portland, OR, USA

² Department of Communication Sciences and Disorders, University of South Florida, Tampa, FL, USA

*Corresponding author, mdutta@pdx.edu

Introduction

Individuals with mild aphasia frequently experience challenges in everyday communication, returning to work, and community reintegration (Armstrong et al., 2013; Cavanaugh & Haley, 2020), yet the nature of cognitive-linguistic impairments in this population is poorly understood. Discourse analysis has emerged as an ecologically valid method for detecting the subtle language difficulties characteristic of mild aphasia (DeDe & Salis, 2020; Dutta et al., 2024; Fromm et al., 2017). However, commonly used discourse tasks—such as picture descriptions and narratives—may not fully capture the complexity of their impairments. Expository discourse, which draws upon more advanced cognitive and linguistic skills, offers a valuable means of identifying these high-level deficits (Kim et al., 2024), although it remains underutilized in both aphasia research and clinical practice. Accordingly, the present study examined cognitive and discourse abilities in individuals with mild aphasia, as well as the relationship between cognition and discourse.

Methods

Twelve persons with mild and very mild aphasia (PWA; WAB-R [Western Aphasia Battery – Revised, Kertesz, 2007] Aphasia Quotient mean = 88.72 ± 9.27) and 12 age- and education-matched neurologically healthy adults (NHA; MoCA [Montreal Cognitive Examination [Nasreddin et al., 2005] mean = 28.25 ± 1.65) participated (Table 1). All completed two expository discourse tasks (healthcare and homeschooling topics) and three NIH Toolbox cognitive tasks assessing processing speed (PCPS), inhibition (Flanker), and cognitive flexibility (DCCS).

Results

PWA scored significantly lower than NHA on the DCCS and PCPS tasks, with no difference on the Flanker task. They also showed longer response times (RTs) across all tasks. In discourse, significant group differences emerged for both healthcare and homeschooling topics. Although PWA produced more words during the homeschooling task, their output was significantly less informative, efficient, and coherent (Table 1). In contrast, during the healthcare task, they were less efficient but more coherent than controls.

Controlling for aphasia severity, for healthcare, discourse informativeness was associated with PCPS accuracy ($r = -.632$, $p = .034$) and RTs ($r = .784$, $p = .006$). Greater discourse efficiency was linked to higher Flanker accuracy ($r = .737$, $p = .012$).

and longer DCCS RTs ($r = .636, p = .033$), while longer Flanker RTs were correlated with lower global coherence ($r = -.701, p = .018$). In the homeschooling task, better discourse efficiency correlated with longer DCCS RTs ($r = .606, p = .042$), and lower coherence was tied to longer RTs on both Flanker ($r = -.704, p = .017$) and DCCS ($r = -.648, p = .030$) tasks. Among controls, homeschooling discourse efficiency was positively associated with PCPS accuracy ($r = .691, p = .006$) and negatively with RTs on the PCPS ($r = -.685, p = .007$) and DCCS ($r = -.565, p = .028$) tasks.

Conclusions

Individuals with milder forms of aphasia differ notably from those without aphasia in both cognitive and discourse abilities. Our results suggest that processing speed is linked to discourse performance in both groups, but differently: in controls, faster processing enhances discourse, while in individuals with aphasia, slower processing supports efficiency but reduces global coherence.

References

- Armstrong, E., Fox, S., & Wilkinson, R. (2013). Mild Aphasia: Is This the Place for an Argument? *American Journal of Speech-Language Pathology*, 22(2), S268–S278. [https://doi.org/10.1044/1058-0360\(2012/12-0084\)](https://doi.org/10.1044/1058-0360(2012/12-0084))
- Cavanaugh, R., & Haley, K. L. (2020). Subjective Communication Difficulties in Very Mild Aphasia. *American Journal of Speech-Language Pathology*, 29(1S), 437–448. https://doi.org/10.1044/2019_AJSLP-CAC48-18-0222
- DeDe, G., & Salis, C. (2020). Temporal and Episodic Analyses of the Story of Cinderella in Latent Aphasia. *American Journal of Speech-Language Pathology*, 29(1S), 449–462. https://doi.org/10.1044/2019_AJSLP-CAC48-18-0210
- Dutta, M., Murray, L. L., & Stark, B. C. (2024). The Relationship Between Executive Functioning and Narrative Language Abilities in Aphasia. *American Journal of Speech-Language Pathology*, 33(5), 2500–2523. https://doi.org/10.1044/2024_AJSLP-23-00314
- Fromm, D., Forbes, M., Holland, A., Dalton, S. G., Richardson, J., & MacWhinney, B. (2017). Discourse Characteristics in Aphasia Beyond the Western Aphasia Battery Cutoff. *American Journal of Speech-Language Pathology*, 26(3), 762–768. https://doi.org/10.1044/2016_AJSLP-16-0071
- Kertesz, A. (2007). *Western Aphasia Battery-Revised*. The Psychological Corporation, San Antonio, TX.
- Kim, H., Kintz, S., & Wright, H. (2024). Preliminary findings of expository discourse in older adults: The impact of cognition, social support, and gender. *Journal of Language and Aging Research*, 2(2), Article 2. <https://doi.org/10.15460/jlar.2024.2.2.1325>
- Nasreddine, Z. S., Phillips, N. A., Bacdirian, V., Charbonneau, S., Whitehead, V., Collin, I., . . . Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A Brief Screening Tool For Mild Cognitive Impairment. *Journal of the American Geriatrics Society*, 53(4), 695–699. <https://doi.org/10.1111/j.1532-5415.2005.53221.x>

Acknowledgments

We sincerely thank all research participants for their involvement in this study. We also appreciate the contributions of the undergraduate and graduate research assistants from the ALC Lab (Portland State University) and LASER Lab (University of South Florida) for their support with data coding and analysis. This research was supported by the Faculty Development Grant by Portland State University (awarded to Dr. Manaswita Dutta) and the CBCS internal grant by the University of South Florida (awarded to Dr. Hana Kim).

Table 1. Demographics, Cognitive Assessment and Discourse Analysis Scores, for Persons with Aphasia (PWA) and Neurologically Healthy Adult (NHA).

Variable	PWA (n = 12)	NHA (n = 12)	Group Comparison Statistic
Demographics			
Age (years)	67.30 ± 9.91	66.45 ± 15.38	U = 63.50, <i>p</i> = .630
Education (years)	16.20 ± 2.74	16.16 ± 1.94	U = 69.00, <i>p</i> = .887
Western Aphasia Battery - AQ	88.72 ± 9.27	-	-
Montreal Cognitive Assessment Total Score	-	28.25 ± 1.65	-
Cognitive Assessment Results			
Flanker - Accuracy	29.55 ± 1.03	29.92 ± 0.28	U = 58.50, <i>p</i> = .651
Flanker – RT *	1.60 ± 1.45	0.81 ± 0.30	U = 16.00, <i>p</i> = .001
DCCS - Accuracy *	25.18 ± 2.99	29.33 ± 0.77	U = 19.00, <i>p</i> = .003
DCCS – RT *	1.57 ± 0.83	0.54 ± 0.16	U = 11.00, <i>p</i> < .001
PCPS - Accuracy *	48.40 ± 17.60	76.42 ± 25.57	U = 19.00, <i>p</i> = .006
PCPS – RT *	1.96 ± 1.16	1.14 ± 0.40	U = 21.00, <i>p</i> = .009
Spoken Discourse Analysis Results			
<i>Healthcare</i>			
Total Words	188.16 ± 153.89	205.16 ± 130.09	U = 60.50, <i>p</i> = .514
CIU	149.75 ± 135.28	173.00 ± 107.93	U = 53.00, <i>p</i> = .291
%CIU	72.56 ± 22.93	87.66 ± 7.62	U = 39.00, <i>p</i> = .060
CIUs per minute*	67.88 ± 34.31	105.13 ± 34.45	U = 29.00, <i>p</i> = .012
Coherence	3.57 ± 2.67	3.40 ± 0.30	U = 17.50, <i>p</i> < .001

<i>Homeschooling</i>			
Total Words	249.25 ± 305.84	201.58 ± 134.32	U = 61.00, <i>p</i> = .551
CIU	200.91 ± 288.98	178.58 ± 122.37	U = 49.00, <i>p</i> = .198
%CIU	74.67 ± 17.98	88.67 ± 8.81	U = 32.00, <i>p</i> = .020
CIUs per minute*	67.84 ± 28.27	103.48 ± 39.95	U = 32.00, <i>p</i> = .020
Coherence*	2.79 ± 0.92	3.65 ± 0.24	U = 28.00, <i>p</i> = .010

Note. AQ = Aphasia Quotient; RT = Response time; DCCS = Dimensional Chance Card Sorting; PCPS = Pattern Comparison Processing Speed; CIU = Correct Information Unit
 * = significant group differences (*p* < .05).

Morphology vs. Word Order in Agrammatic Aphasia: A Cross-Linguistic Study of Moroccan Arabic and English

Loubna El Ouardi^{1*} and Yasmeen Farooqi-Shah²

¹ Applied Language and Culture Studies Lab, Chouaib Doukkali University, El Jadida, Morocco

² Department of Hearing and Speech Sciences, University of Maryland, College Park, Maryland, United States

*corresponding author, loubna-wardi@outlook.fr

Introduction

Agrammatism is characterized by impoverished grammatical morphology. However, this definition may not fully capture agrammatism in typologically diverse languages. This study examines verb morphology and word order in Moroccan Arabic (MA) and English, which differ in morphological complexity and word order rigidity. MA has rich inflection and flexible word order, whereas English has a more rigid word order and less morphological complexity. According to the Competition Model (Bates & MacWhinney, 1989), functionally important cues in a language are better preserved in agrammatism. Usage-based (UB) theories (Martínez-Ferreiro et al., 2020) similarly suggest that frequent linguistic elements are more resilient to impairment. Given MA's reliance on verb morphology, it was hypothesized that morphology would be better preserved than word order. In English, where word order is the primary cue for grammatical relations, it was expected to be better preserved than inflectional morphology.

Methods

Four MA-speaking and five English-speaking persons with agrammatic aphasia (PWAA) participated in this study. Demographic information is presented in **Table 1**. Speech samples from picture description and semi-structured interviews were analyzed using the Quantitative Production Analysis framework (Saffran et al., 1989). Inflectional morphology errors (substitutions and omissions) and word order deviations were coded. The word order-to-morphology error ratio (WOTMER) was calculated, with ratios equal to 1 indicating an equal number of word order and morphology errors, ratios less than 1 indicating more morphology errors, and ratios more than 1 indicating more word order errors.

Results

Table 1 presents the number of morphology and word order errors, while **Figure 1** shows the WOTMERs. MA-speaking PWAA predominantly substituted inflectional morphemes (100% substitutions), whereas English-speaking PWAA primarily omitted them (27% substitutions, 73% omissions). Five of the nine PWAA had WOTMER less than 1, indicating greater difficulty with morphology. This pattern was more pronounced in the MA-speaking PWAA, with all but one participant showing WOTMER less than 1, while the English-speaking PWAA showed a more varied pattern, with 3/5 PWAA showing WOTMER greater than 1, pointing to more difficulties with word order.

Conclusions

Findings revealed cross-linguistic differences in morphological errors. MA morphology was less impoverished (fewer omissions) than English, likely due to the language's requirement to fill inflectional slots for phonological acceptability. The WOTMER findings suggested greater impairment in morphology overall, particularly in MA. This challenges the Competition Model's and UB theory's predictions that functionally important and frequent cues should be better preserved. A possible explanation is that while in MA morphology is central to grammatical encoding, its complexity increases processing cost. In addition, MA's word order flexibility may allow for deviations without producing ungrammatical sentences, reducing the likelihood of word order errors. In the English-speaking PWAA, there was more variability. The rigidity of English word order may have contributed to more word order errors in some PWAA, as deviations often result in ungrammaticality. Overall, findings challenge models assuming uniform patterns of impairment based on functional importance and frequency. Individual variability underscores the importance of a broader framework that considers morphological complexity, word order rigidity, and processing limitations in accounting for agrammatism.

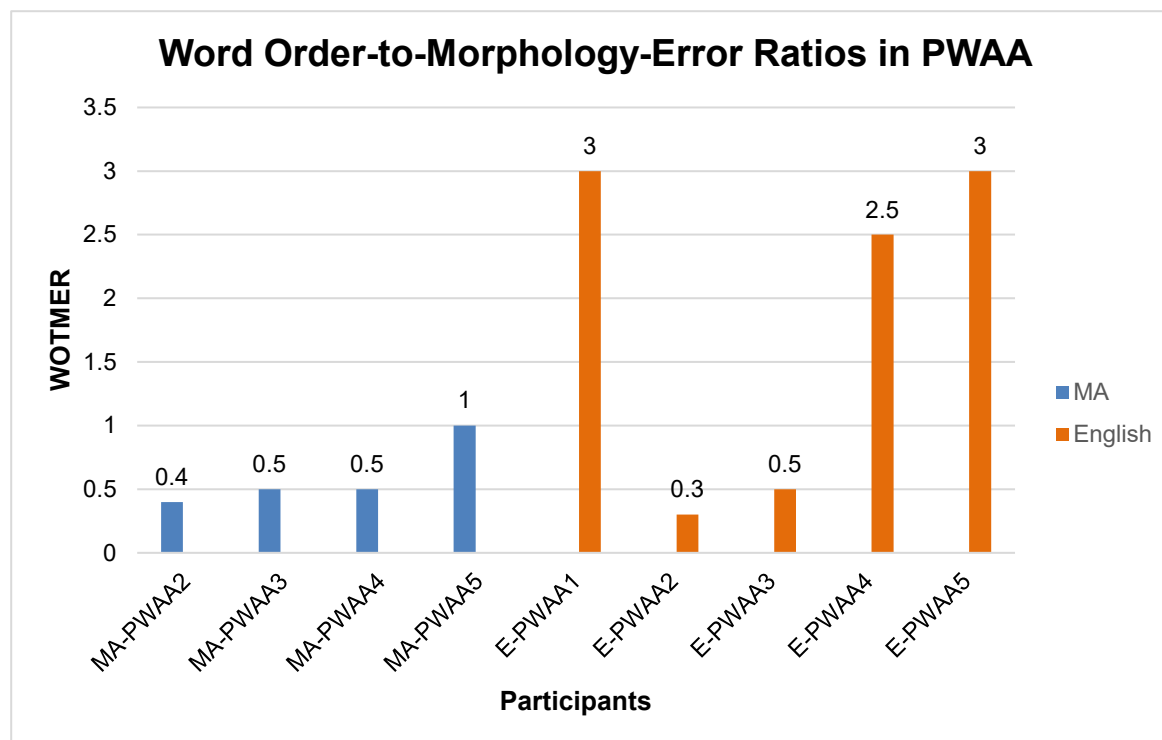
References

- Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney & E. Bates (Eds.), *The crosslinguistic study of sentence processing* (pp. 623–667). New York: Cambridge University Press.
- Martínez-Ferreiro, S., Bastiaanse, R., & Boye, K. (2020). Functional and usage-based approaches to aphasia: the grammatical-lexical distinction and the role of frequency. *Aphasiology*, 34(8), 927–942.
- Saffran, E. M., Berndt, R. S., & Schwartz, M. F. (1989). The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language*, 37(3), 440–479.

Acknowledgments

We would like to thank Mina Nichols, Julia Claire Burk, and Youssef Rami for assistance with data coding and verification. LE was supported by the Fulbright Joint-Supervision program. YFS was supported by the National Institutes on Deafness and Other Communication Disorders (NIDCD) (grant # 1R01DC020483).

Figure 1. Results of the word order-to-morphology error ratios for the MA- and English-speaking PWAA.



Notes. MA: Moroccan Arabic; PWAA: person with agrammatic aphasia; WOTMER: word order-to-morphology error ratio.

Table 1. Demographic information on participants

Participant	Gender/Age /Level of education	WAB- R AQ	Total # of words	# Verbs	# Inflection errors (prop. Accuracy)	# SS	# Word order errors (prop. Accuracy)
MA Speakers							
MA-PWAA2	F/47/9	63.3	86	11	4/11 (0.5)	11	2/11 (0.8)
MA-PWAA3	F/47/15	63.3	92	9	1/9 (0.8)	12	1/12 (0.9)
MA-PWAA4	M/58/5	62.5	142	18	2/18 (0.8)	19	1/19 (0.9)
MA-PWAA5	M/41/6	59.1	175	39	4/39 (0.8)	37	4/37 (0.8)
Mean	---/48.2/8.7	62	123.7	19.2	0.72	19.7	0.85
English Speakers							
E-PWAA1	F/68/18	77.2	392	74	4/74 (0.9)	61	13/61 (0.7)
E-PWAA2	M/74/NA	67.3	145	10	6/10 (0.4)	7	1/7 (0.8)
E-PWAA3	M/46/18	78.7	561	95	13/95 (0.8)	60	7/60 (0.9)
E-PWAA4	M/47/20	56	283	39	7/39 (0.8)	33	15/33 (0.5)
E-PWAA5	M/65/15	69.9	181	29	3/29 (0.9)	22	5/22 (0.7)
Mean	---/60/17.7	69.8	312.4	49.4	0.76	36.6	0.72

Notes. E: English; MA: Moroccan Arabic; prop: proportion; PWAA: person with agrammatic aphasia; SS: sentences; WAB-R AQ: Western Aphasia Battery-Revised Aphasia Quotient; #: number.

Effects of Dysarthria on Toisanese Tone Production: A Case Study

Nancy Eng^{*1,2}, Stanley Chen¹, and Stella Yank¹

¹ Speech-Language Pathology & Audiology, Hunter College, New York, NY, USA

²Speech and Hearing Sciences, Graduate Center/CUNY New York, YN, USA

***corresponding author, neng@hunter.cuny.edu**

Introduction

Dysarthria is a neurological motor speech disorder resulting in weakened or paralyzed muscles, affecting the speed, accuracy, range of motion, and tone of speech production. Dysarthria in cerebral palsy interrupted control of F0, reducing tone contrasts among Cantonese tones (Whitehill et al., 2000b). Excessive variability and difficulty sustaining pitch levels are characteristic of the impact dysarthria has on tone intelligibility. Mandarin speakers with cerebral palsy also show attempts at lexical tone contrasts but with less distinction than their unimpaired peers (Jeng et al., 2006). These and other reports document tone disruptions owing to reduced control of pitch.

Toisanese is one of four sub-dialects of the Yue dialect, spoken in parts of Guangzhou, China. Immigrants from this region began arriving in the US, in part, to help build the western section of the transcontinental railroad. Today, Toisanese speakers are found in many Chinese American communities. There are five contrastive lexical tones in Toisanese: high, mid, low, mid-falling, and low-falling; no tone sandhi is used (Cheng, 1973).

Research on dysarthria's effects on lexical tone production remains limited. Probing into how dysarthria manifests in different languages serves to add to this growing body of knowledge. This study investigated the impact of dysarthria on Toisanese tone production.

Methods

Participant: MM is a 44-year-old male native Toisanese speaker presenting with severe dysphonia, dysarthria, and dysphagia secondary to bilateral toxic-metabolic or ischemic changes. History is significant for substance abuse, including opium, fentanyl, and methadone. Neurological concerns include slow, poorly coordinated gait and fasciculation. No marked aphasia observed. Speech production is consistent with a mixed dysarthria.

Materials: Four cognate sets were created, each consisting of five Toisanese words sharing the same syllable but differing in lexical tone. MM repeated each word following a model. A healthy native Toisanese speaker served as MM's control. Another five native Toisanese speakers assessed subjective intelligibility. PRAAT software was used to extract each monosyllable's onset and offset F0 values, along with tone duration, to examine pitch height and contour.

Results

Native listeners judged his overall accuracy rate to be 36.1%, with T1 (high level) being the most difficult to perceive (6% accuracy) and T3 (low level) the easiest to perceive (53% accuracy). These ratings are consistent with PRAAT extracted acoustical data. Statistically significant differences were noted between MM and the control's mean onset and offset

F0s and respective syllable duration across all five tones. MM failed to sustain level tones, making them particularly difficult to discern subjectively. Unlike the control, MM's syllables were nearly all the same duration.

Conclusions

Comparative analysis of perceptual and acoustic data suggests lexical tone production deficits across MM's tone profile. Maintaining level and rising tones is challenging compared to low-level tones. The lack of durational contrast further erodes tone contrast. Variability in perceptibility suggests treatment opportunities and that tones are affected differently in dysarthria, depending on the contour requirements of each tone. Through constructing a detailed tone profile for MM, this research seeks to enhance the understanding of dysarthria-related tone deficits and inform therapeutic interventions for speakers of tonal languages.

References

- Cheng, T. M. (1973). The phonology of Taishan. *Journal of Chinese Linguistics*, 1(2), 256–322.
- Jeng, J. Y., Weismer, G., & Kent, R. D. (2006). Production and perception of Mandarin tone in adults with cerebral palsy. *Clinical Linguistics & Phonetics*, 20(1), 67–87. <https://doi.org/10.1080/02699200400016539>
- Whitehill, T. L., & Ciocca, V. (2000). Speech errors in Cantonese speaking adults with cerebral palsy. *Clinical Linguistics & Phonetics*, 14(2), 111–130.

Assessing the cognate facilitation effect in anomia therapy: Evidence from two Spanish-Catalan bilinguals with aphasia

Andrea Escoté^{1,2,3*}, Margherita Montuori^{1,2}, Alejandro Villanueva⁴, Inmaculada Rico Pons⁵, Andrés Paipa⁵, Claudia Peñaloza^{1,2,3}

¹Department of Cognition, Development and Educational Psychology, University of Barcelona, Barcelona, Spain

²Cognition and Brain Plasticity Unit, Bellvitge Biomedical Research Institute (IDIBELL), L'Hospitalet de Llobregat, Spain

³Institute of Neurosciences, University of Barcelona, Barcelona, Spain

⁴Department of Rehabilitation, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Spain

⁵Department of Neurology, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Spain

***corresponding author, andreaescotei@ub.edu**

Introduction

Studies involving neurotypical bilinguals support a facilitation effect in language processing for words that share meaning and form across languages (cognates) relative to those only sharing meaning (non-cognates) (Costa et al., 2000). Similarly, this cognate advantage has been observed in picture naming in bilinguals with aphasia (BWA) (Marte et al., 2023), suggesting that cognates may show superior improvement relative to non-cognates during anomia therapy both in the treated language (direct treatment effects) and the untreated language (cross-language generalization). However, evidence from bilingual aphasia rehabilitation research focused on cognates is both limited and inconsistent (Kohnert 2004; Kurland & Falcon, 2011), and deserved further research. This study aimed to evaluate the effects of anomia treatment on the treated and the untreated language for cognates versus non-cognates in two Spanish-Catalan BWA with different profiles of bilingualism and language impairment.

Methods

P1 (female, 67 years-old, 39 months post-stroke) was an unbalanced Spanish-dominant bilingual with severe non-fluent post-stroke aphasia (frontal and basal ganglia damage). P2 (female, 65 years-old, 17 months post-brain injury) was a balanced Spanish-Catalan bilingual with mild, fluent aphasia resulting from a brain aneurism surgery (temporo-parieto-occipital lesions).

Both participants received semantic anomia treatment in Spanish (12 sessions/4 weeks). They completed an extensive bilingual picture naming task to identify study items (Spanish = 14 treated items: 7 cognates, 7 non-cognates; 14 control items: 7 cognates, 7 non-cognates; Catalan = 28 corresponding translations). Naming ability for all items was assessed in both languages across 3 baseline naming probes (BNP), 6 treatment naming probes (TNP-administered every other treatment session) and 3 post-treatment naming probes (PTNP).

Results

P1 is still to complete all PTNP. Her preliminary results on TNP6 showed higher accuracy on treated (28,57%) versus control items (0%). Her scores on TNP6 for treated cognates and non-cognates were identical (28,57%), suggesting no cognate advantage. Moreover, no cross-language generalization to Catalan was observed (accuracy for all TNPs = 0%). Overall, her naming performance remained in the range of her BNPs.

P2's treatment outcomes computed as the proportion of the potential maximal gain (PMG) (Lambon-Ralph et al., 2010), showed a clear benefit for treated items in Spanish (PMG = 1), with comparable gains for cognates and non-cognates (PMG = 1). Cross-language generalization across all treated item translations was also found (PMG = 0.31), with superior gains for treated cognates (PMG = 0.40) versus non-cognates (PMG = 0.21).

Conclusions

We found differential treatment outcomes for P1 and P2. While P1 showed no significant treatment effects, P2 showed substantial overall treatment gains in the treated language and a cognate advantage on cross-language generalization. These findings suggest that the cognate advantage in anomia therapy for BWA may depend on individual differences in premorbid language proficiency and language impairment after brain injury, two important factors contributing to treatment outcomes in BWA (Peñaloza & Kiran, 2019).

References

- Costa, A., Caramazza, A., & Sebastian-Galles, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26(5), 1283–1296.
- Kohnert, K. (2004). Cognitive and cognate-based treatments for bilingual aphasia: A case study. *Brain and Language*, 91(3), 294–302.
- Kurland, J., & Falcon, M. (2011). Effects of cognate status and language of therapy during intensive semantic naming treatment in a case of severe nonfluent bilingual aphasia. *Clinical Linguistics & Phonetics*, 25(6–7), 584–600.
- Lambon Ralph, M. A., Snell, C., Fillingham, J. K., Conroy, P., & Sage, K. (2010). Predicting the outcome of anomia therapy for people with aphasia post CVA: Both language and cognitive status are key predictors. *Neuropsychological Rehabilitation*, 20(2), 289–305.
- Marte, M. J., Peñaloza, C. & Kiran, S. (2023). The cognate facilitation effect on lexical access in bilingual aphasia: Evidence from the Boston Naming Test. *Bilingualism: Language and Cognition*, 26(5), 1009–1025.
- Peñaloza, C., & Kiran, S. (2019). Recovery and Rehabilitation Patterns in Bilingual and Multilingual Aphasia. In J. W. Schwieter & M. Paradis (Eds.), *The Handbook of the Neuroscience of Multilingualism* (pp. 553–571). John Wiley & Sons, Ltd.

Acknowledgments

This study was supported by grant PID2023-151781OA-I00 awarded to Claudia Peñaloza and an FPI scholarship PRE2023-001613 awarded to Andrea Escoté, both funded by Ministerio de Ciencia, Investigación y Universidades MICIU/AEI /10.13039/501100011033 y por FEDER, European Union. Claudia Peñaloza was further supported by grant RYC2021-034561-I funded by MCIN/AEI/10.13039/501100011033 and the European Union NextGenerationEU/PRTR.

Clustering and Switching in Verbal Fluency Tasks: Potential indicators of Cognitive Degradation in Elderly Galician-Spanish Bilinguals

**Ana María Estrada Pineda^{1*}, José Carlos Jesús Millán Calenti², Michael Rießler³,
Silvia Martínez-Ferreiro⁴**

1 European Master's in Clinical Linguistics EMCL++, University of Groningen,
Groningen, Netherlands

2 Gerontology and Geriatrics Research Group, Instituto de Investigación Biomédica de A
Coruña (INIBIC), Complejo Hospitalario Universitario de A Coruña (CHUAC), SERGAS,
Universidade da Coruña, A Coruña, Spain

3. School of Humanities, University of Eastern Finland, Joensuu, Finland

4. Department of Psychology, Faculty of Education Sciences, Universidade da Coruña, A
Coruña, Spain

***corresponding author, a.m.estrada.pineda@student.rug.nl**

Introduction

As global life expectancy increases, dementia becomes a major healthcare challenge (Corrada et al., 2009). In this context, early detection of cognitive decline is crucial for enabling timely treatment and enacting lifestyle changes that help preserve cognitive function. Verbal Fluency Tasks (VFTs)—generating words belonging to a category [Semantic fluency] or beginning with a specific letter [Letter fluency] within a time limit — hold potential for the early detection of cognitive degradation (Wright et al., 2023). This study examines clustering (producing words within subcategories) and switching (shifting between subcategories) during VFTs as potential indicators of cognitive degradation in elderly Galician-Spanish bilinguals. Both languages have co-official status in the autonomous region of Galicia, northwest Spain, and they have a noticeable influence on each other at all linguistic levels (Estévez et al., 2012). The impact on the cognitive performance of aging populations of the bilingual dynamics of a region where not only individuals, but their society is largely bilingual, remains underexplored.

Methods

Our sample included 53 participants (30 controls, 23 experimental) from the SECONDSGALES (PID2023-151673OB-I00; Ministry of Science, Innovation & Universities) research project. Verbal fluency performance was analyzed across three tasks: “Animals” for semantic fluency (Ojeda et al., 2016), and the letters “S” and “P” for letter fluency (Martínez-Ferreiro et al., 2024). Responses—including errors and code-switched words—were transcribed and time-stamped using PRAAT (Boersma & Weenink, 2025), and verbal fluency measures (total word count, mean cluster size, and number of switches) were extracted using SNAFU (Zemla et al., 2020). We used RStudio (Posit, 2025) to implement linear mixed-effects models and evaluate the extent to which verbal fluency measures can differentiate between healthy controls, clinical groups and dementia subtypes.

Results

Preliminary results from the semantic fluency task suggest that the average number of switches can distinguish between cognitively healthy and cognitively impaired participants (estimate = -3.94, 95% CI = [-5.41 – -2.48], $p = <0.001$). In contrast, average cluster size did not significantly differentiate among participant groups (estimate = -0.12, 95% CI = [-0.42 – 0.18], $p = 0.441$). When participants were grouped based on their MoCA scores, the number of switches significantly differentiated healthy individuals from those with severe cognitive impairment (estimate = -5.19, 95% CI [-7.18 – -3.20], $p = <0.001$). The mild impairment group showed a trend toward significance (estimate = -2.4, 95% CI [-4.65 – -0.26], $p = 0.029$).

Conclusion

So far, the average number of switches appears sensitive enough to distinguish between healthy and cognitively impaired individuals. We expect that including data from the letter fluency tasks (ongoing) will provide a more comprehensive understanding of participants' verbal fluency profiles and their relation to cognitive deterioration.

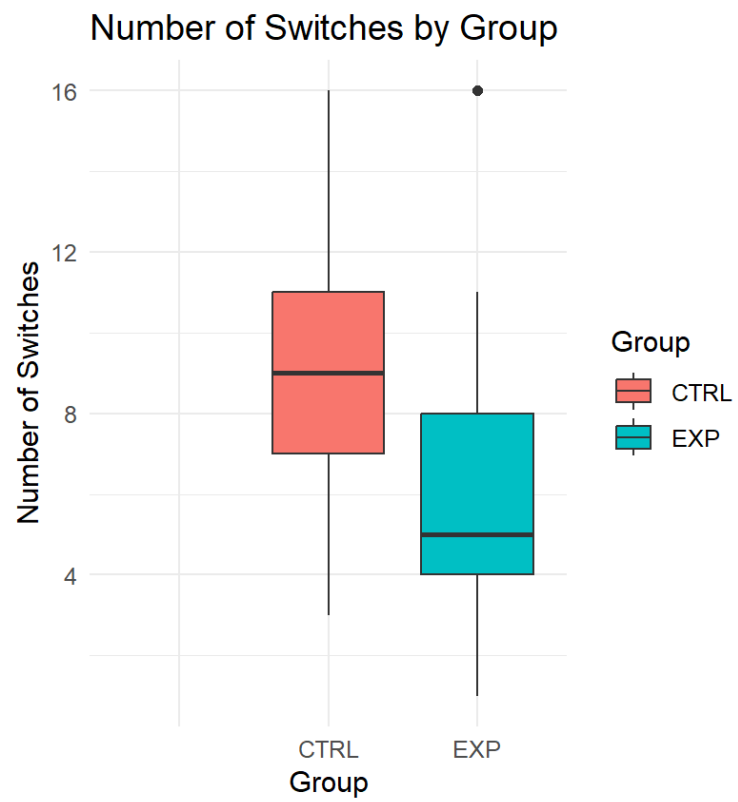
References

- Boersma P., Weenink D. (2025). Praat Doing phonetics by computer (Version 6.4. 27) [Computer Software]
- Corrada, M. C., Brookmeyer, R. B., Paganini-Hill, A. P., Berlau, D. B., & Kawas, C. H. K. (2009). Dementia incidence continues to increase with age in the oldest old the 90+ study. *Annals of Neurology*, 67(1), 114–121.
<https://doi.org/10.1002/ana.21915>
- Ojeda, N., Del Pino, R., Ibarretxe-Bilbao, N., Schretlen, D. J., & Peña Lasa, J. (2016). Test de evaluación cognitiva de Montreal normalización y estandarización de la prueba en población española. *Revista De Neurología*, 63(11), 488–496.
<https://dialnet.unirioja.es/servlet/articulo?codigo=5736681>
- Martínez-Ferreiro, S., Quique, Y. M., Rodríguez, V. A., & Orellana, C. M. (2024). Linguistic and cultural properties of the Spanish adaptation of the CAT (SP-CAT): pilot results from neurotypical subjects. *Aphasiology*, 1–25.
<https://doi.org/10.1080/02687038.2024>
- Posit. (2025, January 21). RStudio (Version 2025.05.0+496) [Computer Software]
<https://posit.co/download/rstudio-desktop/>
- Wright, L. M., De Marco, M., & Venneri, A. (2023). Current Understanding of Verbal Fluency in Alzheimer's Disease: Evidence to Date. *Psychology research and behavior management*, 16, 1691–1705. <https://doi.org/10.2147/PRBM.S284645>

Acknowledgements

SMF acknowledge support of PID2023-151673OB-I00, MCIN/AEI/10.13039/501100011033 & FEDER, EU and RYC2020-028927-1, MICIU/AEI /10.13039/501100011033 y por El FSE invierte en tu futuro.

Figure 1.



Response time modeling to predict optimal patient and item-specific confrontation naming deadlines

William S. Evans,^{1*} Jeffrey Starns²

¹ Department of Communication Sciences and Disorders, University of Pittsburgh, Pittsburgh, PA, USA

² Department of Psychology, University of Massachusetts, Amherst, MA, USA

***corresponding author, will.evans@pitt.edu**

Introduction

Aphasia negatively affects the accuracy and speed of language performance. Accurate model-based prediction of both accuracy and response time (RT) performance could support various therapeutic applications, such as diagnostics, improving communication efficiency, and optimal timing of treatment cue delivery.

In previous work, we developed a multinomial ExGaussian RT picture naming model that accurately predicts patient-specific optimal RT cutoffs (e.g., the deadline that maximizes the proportion of correct responses in the shortest amount of time). We have applied this model in an ongoing anomia clinical trial (NCT05653440) to adaptively maintain desirable difficulty (Bjork & Bjork, 2020) during retrieval practice. However, this model does not account for word-specific production difficulty, potentially mischaracterizing cutoffs for atypically hard or easy-to-produce words.

Changes in word complexity produce changes in every aspect of the RT distributions. Fortunately, evidence accumulation models, such as the diffusion model (Ratcliff, 1978), can robustly capture complex distributional changes with a single parameter. We explored the possibility of modeling production complexity in terms of a drift rate parameter in a single-bound diffusion process, characterized by the Wald distribution. Given that the ExGaussian distribution often provides a superior fit to RT distributions, we created a hybrid model that combined elements of both distributions.

Study aims:

1. Develop a new quantitative RT picture naming model that can account for production complexity.
2. Evaluate model fit.
3. Demonstrate the performance of new item-specific optimal RT cutoffs compared to the base model.

Methods

Our hybrid model parameterized a Wald response boundary, a Wald drift rate that varied as a function of word complexity, and a shape fitting parameter that translates Wald parameters to ExGaussian distributions across complexity levels. We fit the model to naming probe data from 12 participants from a previous anomia treatment study (Evans et al., 2021). Word production difficulty was estimated via a validated naming complexity score (Fergadiotis et al., 2019).

Results

The ExGaussian-Wald hybrid model demonstrated improved fit vs. ExGaussian-only or Wald-only models (weighted AIC, Table 1). Higher complexity was associated with lower evidence accumulation (i.e., drift rate). Figure 1 left panel shows a close fit to observed RT distributions, while the right panel shows the improved granularity of optimal RT cutoffs. For example, while our previous model predicts an overall optimal RT cutoff of ≈ 6 seconds, this under or over-estimates complexity-adjusted optimal cutoffs for the easiest and hardest words by ≈ 2 -3 seconds.

Conclusions

Our new model successfully accounts for the effect of word production complexity by varying a single parameter (the Wald drift rate). As a result, it can be used to predict patient-specific accuracy and RT performance for words of varying production complexity, which will support advances in anomia treatment and assessment. Harder words were associated with lower evidence accumulation, which is consistent with previous aphasia research examining other language-dependent tasks (Evans et al., 2019). While our current focus is clinical utility, this shift to an evidence accumulation framework could support advances in computational models of single word production in aphasia by considering RT dynamics (Anders & Alario, 2019).

References

- Anders, R., & Alario, F. X. (2019). Challenges to developing time-based signal detection models for word production. *Cognitive Neuropsychology*, 36(1–2), 85–88. <https://doi.org/10.1080/02643294.2019.1581603>
- Bjork, R. A., & Bjork, E. L. (2020). *Bjork, R. A., & Bjork, E. L. (2020). Desirable difficulties in theory and practice. 9, 475–479.*
- Evans, W. S., Cavanaugh, R., Quique, Y., Boss, E., Starns, J. J., & Hula, W. D. (2021). Playing with bears: Balancing effort, accuracy, and response speed in a semantic feature verification anomia treatment game. *Journal of Speech, Language, and Hearing Research*, 64(8), 3100–3126. https://doi.org/10.1044/2021_JSLHR-20-00543
- Evans, W. S., Hula, W. D., & Starns, J. J. (2019). Speed–Accuracy Trade-Offs and Adaptation Deficits in Aphasia: Finding the “Sweet Spot” Between Overly Cautious and Incautious Responding. *American Journal of Speech-Language Pathology*, 28(1S), 259–277. https://doi.org/10.1044/2018_AJSLP-17-0156
- Fergadiotis, G., Swiderski, A., & Hula, W. D. (2019). Predicting confrontation naming item difficulty. *Aphasiology*, 33(6), 689–709. <https://doi.org/10.1080/02687038.2018.1495310>
- Ratcliff, R. (1978). A Theory of Memory Retrieval. *Psychological Review*, 85(2), 59–108. <https://doi.org/10.1037/0033-295X.85.2.59>

Acknowledgments

This work is funded by NIH NIDCD 1R01DC019325. We would like to thank William Hula, Candace van der Stelt, and Mara Goodman for input during model development.

Figure 1. Left Panel: Empirical vs. predicted RT distributions of the new Wald-ExGaussian hybrid model for high vs. low complexity words. Right panel: predicted RT distributions and corresponding optimal RT cutoffs (noted by vertical bars) for the new hybrid model across the distribution of word complexity scores (“complexity benchmark”). The optimal RT cutoff from the original base ExGaussian model (“Collapsed cue time”) is provided for comparison. M = mean word complexity, SD = standard deviation.

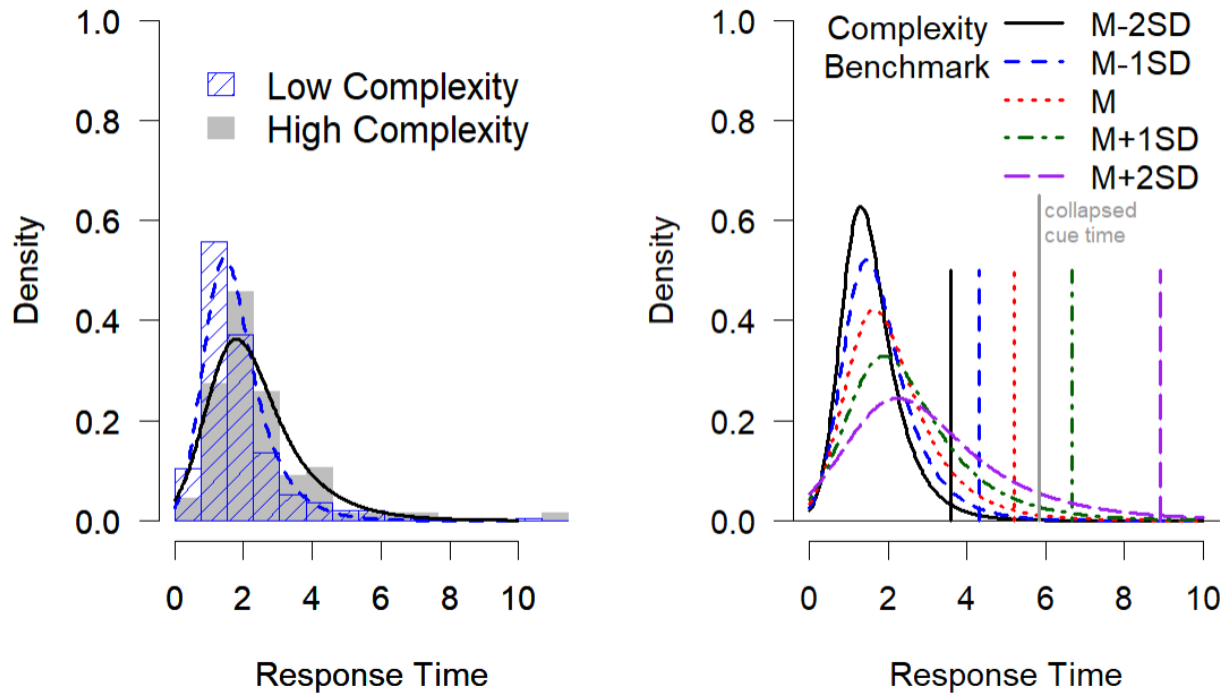


Table 1. Fit of new Wald-ExGaussian hybrid model to low and high word complexity data (median split) compared to the base ExGaussian model and an alternative Wald-only model. The hybrid model demonstrated the best fit per AIC weight, which accounts for the number of model parameters.

Model	G^2	# of parameters	AIC weight
ExGaussian	5.32	6	.22
Wald	10.59	3	.31
Hybrid	7.76	4	.47

Quick Aphasia Battery in Primary Progressive Aphasia

Zoe Ezzes^{1*}, Lisa D. Wauters², Isabel E. Allen¹, Boon Lead Tee¹, Rian Bogley¹, Mia Lin¹, Siddarth Ramkrishnan¹, Diana A. Rodriguez¹, Maria Luisa Mandelli¹, Stephen M. Wilson³, Maya Henry², Zachary A. Miller¹, Maria Luisa Gorno-Tempini¹

¹ Memory and Aging Center, Department of Neurology, University of California San Francisco, San Francisco, California, USA

² Department of Speech, Language, and Hearing Sciences, University of Texas at Austin, Austin, Texas, USA

³ School of Health and Rehabilitation Sciences, University of Queensland, Brisbane, Australia

***corresponding author, zoeezzes@gmail.com**

Introduction

Primary progressive aphasia (PPA) is a rare neurodegenerative syndrome characterized by a gradual decline in speech and/or language abilities (Mesulam, 2001). There are three primary subtypes: the nonfluent variant (nfvPPA), the logopenic variant (lvPPA), and the semantic variant (svPPA) (Gorno-Tempini et al., 2011). It can be difficult to accurately diagnose PPA and phenotype by variant, in part because most language batteries are designed for aphasia due to stroke, which is more common. The *Quick Aphasia Battery* (QAB; Wilson et al., 2018) is a freely available assessment tool that is both quick to administer and comprehensive in speech and language domains assessed, but its utility in PPA has not been systematically evaluated. We aimed to determine first whether the QAB could effectively capture speech and language impairment in PPA, and second whether the QAB could be used to accurately classify PPA variants.

Methods

We administered the QAB to 37 individuals with clinically diagnosed PPA (15 nfvPPA, 12 lvPPA, 10 svPPA), all of whom underwent additional comprehensive behavioral testing. The QAB language quotient was calculated for all participants and compared to the published diagnostic threshold indicating presence of aphasia (Wilson et al., 2018).

We assessed concurrent validity by correlating QAB summary scores (seven domain-specific calculated scores, one overall language quotient) with corresponding language and neuropsychological tasks. Analysis of Variance was conducted to assess significance of between-group differences for each individual QAB summary score.

Discriminant analysis was conducted to assess how well all QAB summary scores together could differentiate between variants. Further discriminant analyses were carried out to assess the utility of substituting other language measures for QAB subcomponents in improving classification accuracy.

Results

The QAB language quotient met the diagnostic threshold for aphasia in 31 out of 37 participants. In the remaining six participants, two were motor-speech-dominant presentations of nfvPPA with mild, emerging agrammatism; three were in early disease

stages and performed similarly on other tests; and one had mild semantic impairment that was better captured by other tests.

Individual QAB summary scores were significantly correlated with predicted tasks from other behavioral measures, apart from Sentence Comprehension (Table 1). Five of the eight summary scores showed significant differences between variants (Word Comprehension, Sentence Comprehension, Word Finding, Grammatical Construction, and Speech Motor Programming).

The discriminant analysis revealed that the QAB accurately classified 94.6% of cases into their diagnosed variant (90% of svPPA, 100% of nvfPPA, and 91.7% of lvPPA; Figure 1). Classification accuracy increased to 97.3% when substituting the Bayles Repetition task for the QAB Repetition score, resulting in 100% classification accuracy for lvPPA. Other substitutions trialed did not improve classification.

Conclusions

The QAB accurately identified aphasia in most individuals with PPA, supporting its clinical use. QAB summary scores accurately classified most participants by PPA variant in a discriminant analysis. Further work may validate summary score cutoffs to support accurate variant diagnosis in a clinical setting. Future directions also include repeating the analysis with a larger sample and considering whether modifications would be warranted to create a version of the QAB specifically for use in PPA.

References

- Bayles, K.A., Tomoeda, C.K., & Rein, J.A. (1996). Phrase repetition in Alzheimer's disease: effect of meaning and length. *Brain and Language*, 54(2), 246-261.
- Beeson, P.M. & Rising, K. (2010). Arizona battery for reading and spelling. Retrieved from http://aphasia.arizona.edu/Aphasia_Research_Project/Assessment_Materials
- Cockrell, J.R., & Folstein, M.F. (2002). Mini-mental state examination. *Principles and practice of geriatric psychiatry*, 140-141.
- Dunn, D.M. (2019). *Peabody picture vocabulary test* (5th ed.). [Measurement instrument]. Bloomington, MN: NCS Pearson.
- Gorno-Tempini, M.L., Hillis, A.E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S.F., Ogar, J.M., Rohrer, J.D., Black, S., Boeve, B.F., Manes, F., Dronkers, N.F., Vandenberghe, R., Rascovsky, K., Patterson, K., Miller, B.L., Knopman, D.S., Hodges, J.R., Mesulam, M.M., & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.
- Hughes, C.P., Berg, L., Danziger, W.L., Coben, L.A., & Martin, R.L. (1982). A new clinical scale for the staging of dementia. *The British Journal of Psychiatry*, 140(6), 566-572.
- Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *Boston naming test*. [Measurement instrument]. Philadelphia: Lea & Febiger.
- Knopman, D.S., Kramer, J.H., Boeve, B.F., Caselli, R.J., Graff-Radford, N.R., Mendez, M.F., Miller, B.L., & Mercaldo, N. (2008). Development of methodology for conducting clinical trials in frontotemporal lobar degeneration. *Brain*, 131(11), 2957-2968.

- Knopman, D.S., Weintraub, S., & Pankratz, V.S. (2011). Language and behavior domains enhance the value of the clinical dementia rating scale. *Alzheimer's & Dementia*, 7, 293-299.
- Lukic, S., Mandelli, M.L., Welch, A.E., Jordan, K., Shwe, W., Neuhaus, J., Miller, Z.A., Hubbard, H.I., Henry, M.L., Miller, B.L., Dronkers, N.F., & Gorno-Tempini, M.L. (2019). *Brain and Language*, 194, 35-45.
- Mesulam, M.M. (2001). Primary progressive aphasia. *Annals of neurology*, 49(4), 425-432.
- Wilson, S.M., Eriksson, D.K., Schneck, S.M., & Lucanie, J.M. (2018). A quick aphasia battery for efficient, reliable, and multidimensional assessment of language function. *PLoS ONE*, 13(2), e0192773.

Acknowledgments

Thank you to the individuals with primary progressive aphasia and their study partners for allowing us this opportunity to work with them and to learn how to better serve them clinically. This submission is a scientific paper proposal. Preferred presentation type pending acceptance is a poster presented in the on-site poster hall.

Figure 1. Discriminant analysis of QAB summary scores used to classify PPA variants.

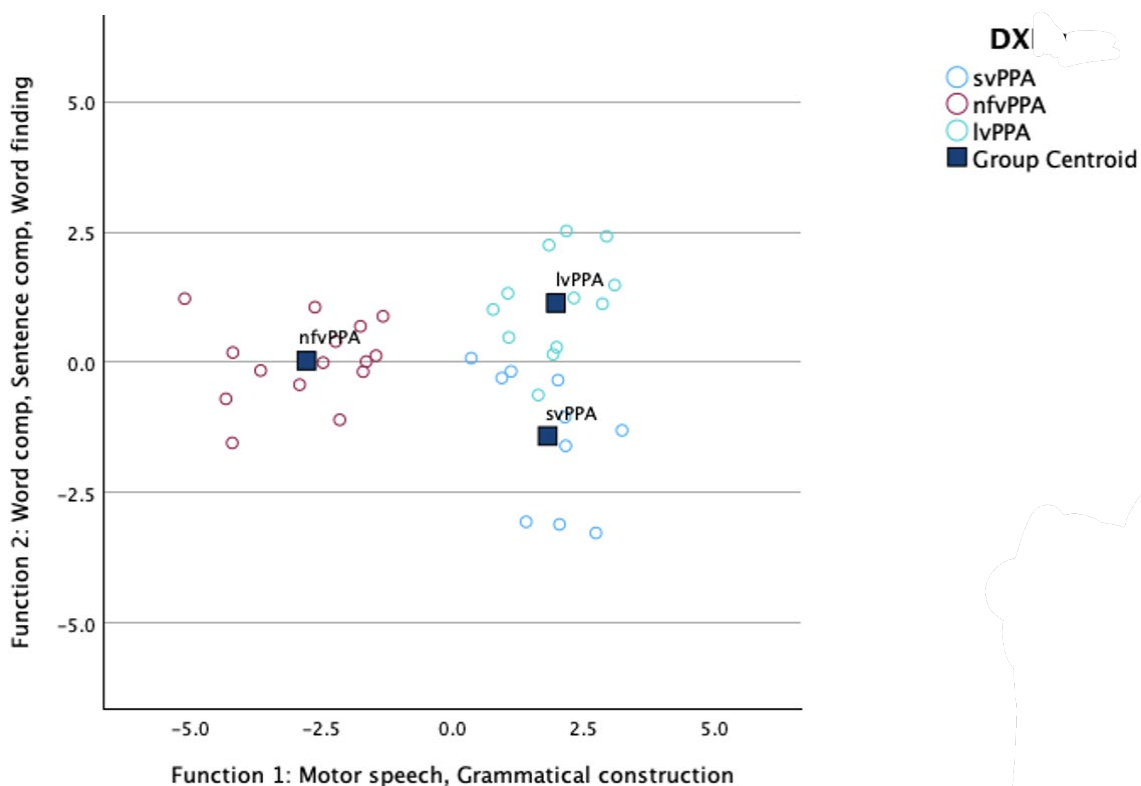


Table 1. Correlation analyses for QAB summary scores and related language and neuropsychological measures.

Tasks	QAB Summary Scores	r	p
PPVT	Word Comprehension	0.827	p < 0.001
BNT	Word Finding	0.829	p < 0.001
Bayles Repetition	Repetition	0.751	p < 0.001
ABRS Reading	Reading	0.696	p < 0.001
SPMT	Sentence Comprehension	0.227	p = 0.190
CDR plus NACC FTLD: Sum of Boxes	Overall Language Quotient	-0.448	p < 0.001
CDR plus NACC FTLD: Language	Overall Language Quotient	-0.565	p < 0.001
MMSE	Overall Language Quotient	0.661	p < 0.001

Notes: PPVT = *Peabody Picture Vocabulary Test* (Dunn, 2019), a single word comprehension test with a short 16-item form used here for research; BNT = *Boston Naming Test* (Kaplan, Goodglass, & Weintraub, 1983), a confrontation naming test with a short 15-item form used here for research; *Bayles Repetition* (Bayles, Tomoeda, & Rein, 1996; Lukic et al., 2019) = a 10-item sentence repetition task; ABRs = *Arizona Battery for Reading and Spelling* (Beeson & Rising, 2010), with a subset of items from the original battery used here comprising a 36-item form for reading aloud real words; SPMT = *Sentence-Picture Matching Test*, a 40-item experimental sentence comprehension task; CDR plus NACC FTLD = *Clinical Dementia Rating (CDR) Dementia Staging Instrument* (Hughes et al., 1982) with the addition of the National Alzheimer's Coordinating Center's (NACC) frontotemporal lobar degeneration (FTLD) module (Knopman et al., 2008; Knopman et al., 2011), a global assessment scale for evaluating cognitive/functional levels and severity of dementia; CDR plus NACC FTLD Sum of Boxes = sum total of eight domains calculated; CDR-Language = just the language domain's score; MMSE = *Mini-Mental State Examination* (Cockrell & Folstein, 2002), a screening tool for cognitive impairment.

SEA-Battery: A new Spanish English Aphasia (SEA) Battery for Bilingual Speakers

Yasmeen Farooqi-Shah*

Department of Hearing and Speech Sciences, University of Maryland, College Park,
Maryland, United States of America

***Corresponding author: yfshah@umd.edu**

Introduction

Bilingual speakers' use of language(s) differs from monolingual speakers in unique and complex ways. This poses significant challenges in diagnosing and subtyping language disorders resulting from focal and degenerative brain injury in bilingual speakers with aphasia (BPWA). In the United States, 70% of clinicians in neurorehabilitation settings report being unprepared to assess bilingual adults, and frequently use non-standard clinical practices such as informal conversational profiling, and English language measures that have been normed on monolinguals and lack bilingual norms (Centeno, 2015). There is a critical need to establish a quick, theoretically sound and psychometrically valid assessment for bilingual speakers that will reliably 1) differentiate neurotypical variation from aphasia, and 2) pinpoint impaired linguistic domains that can be targeted in rehabilitation. The development of the Spanish English Aphasia Battery (SEA-Battery) is aimed at addressing these needs for mid-high proficiency Spanish-English bilingual speakers.

Methods

Development of the SEA-Battery was informed by advances in aphasia and bilingualism. It has three modules: 1) Diagnostic and Severity (DS) Module, which provides an overall aphasia assessment and is modelled after the Quick Aphasia Battery (Wilson et al., 2018), 2) Lexico-Semantic (LS) module, designed to delineate single word semantic and phonological abilities, and 3) Morpho-Syntactic (MS) module, which allows assessment of sentence production, comprehension, and morphosyntactic knowledge. Parallel Spanish and English versions were developed with psycholinguistically matched stimuli. There were initially almost triple the number of stimuli than the intended final number of items. It allows assessment of both verbs and nouns across modules.

Normative data was obtained from 149 neurotypical mid-high proficiency Spanish-English bilingual speakers (114 female, 35 male, Mean age = 43.8 years; age range 30-70 years). Participants were administered a battery of language, socio-cultural, and cognitive assessments (Bilingual Language Profile: Birdsong et al., 2012; discourse scored using ACTFL criteria: Swender et al., 2016; Code-switching attitudes: Farooqi-Shah & Wereley, 2022; LexTALE-English: Lemhofer & Boersma, 2012; LexTALE-Spanish: Izura et al., 2014; MacArthur SES questionnaire: Heath et al., 2012; Abbreviated Multidimensional Acculturation Scale: Zea et al., 2003; criteria for healthy aging: Tyas et al., 2007; and the Montreal Cognitive Assessment: Nasreddine et al., 2005). A subset of participants (N=30) who had acquired both languages before six years of age and had comparable high scores for both languages in background assessments were identified as high proficiency (HP) speakers. Final SEA-Battery item selection was based on a passing rate of at least 90%

by HP speakers. For these final items, passing rates of mid-proficiency Spanish and English speakers were calculated to allow for diagnostic interpretation based on language background.

Diagnostic accuracy (specificity and sensitivity) was determined using 17 bilingual Spanish-English speakers (8 male, 9 female; Mean age = 52.3 years) with a prior diagnosis of aphasia following a left hemisphere cerebrovascular accident.

Reliability include test-retest and inter-rater reliability on 20% of the participants.

Results and Conclusions

Each SEA-Battery module can be administered in less than 20 minutes, and has a specificity-sensitivity exceeding 85%. This is the first psychometrically valid aphasia assessment for mid-high proficiency Spanish-English speakers.

References

- Birdsong, D., Gertken, L. M., & Amengual, M. (2012). *Bilingual Language Profile: An Easy-to-Use Instrument to Assess Bilingualism*.
<https://sites.la.utexas.edu/bilingual/>
- Centeno, J.G. (2015). Assessing services with communicatively impaired bilingual adults in culturally and linguistically diverse neurorehabilitation programs. *Journal of Communication Disorders*, 58, 58-73.
- Faroqi-Shah, Y. & Wereley, S. (2022) Investigation of code-switching cost in conversation and self-paced reading tasks. *International Journal of Bilingualism*, 26, 308-323.
- Izura, C., Cuetos, F., & Brysbaert, M. (2014). Lextale-Esp: A test to rapidly and efficiently assess the Spanish vocabulary size. *Psicologica*, 35, 49-66.
- Lemhöfer, K., & Broersma, M. (2012). Introducing LexTALE: A quick and valid Lexical Test for Advanced Learners of English. *Behavior Research Methods*, 44, 325-343.
- Nasreddine, Z.S., et al. (2005). The Montreal Cognitive Assessment, MoCA: A Brief Screening Tool For Mild Cognitive Impairment. *Journal of the American Geriatrics Society*, 53, 695-699.
- Swender, E., Conrad, D., & Vicars, R. (2016). *ACTFL proficiency guidelines, 2012*.
<https://actfl.org/>
- Tyas, S.L., et al. (2007). Healthy ageing in the Nun Study: definition and neuropathologic correlates. *Age and Ageing*, 36, 650-655.
- Wilson, S. M., Eriksson, D. K., Schneck, S. M., & Lucanie, J. M. (2018). A quick aphasia battery for efficient, reliable, and multidimensional assessment of language function. *PLoS ONE*, 13, e0192773. <https://doi.org/10.1371/journal.pone.0192773>
- Zea, M.C., et al. (2003). The abbreviated multidimensional acculturation scale: empirical validation with two Latino/Latina samples. *Cultural Diversity and Ethnic Minority Psychology*, 9, 107-126.

Acknowledgments

This research was funded by National Institutes of Health grant R21DC018916-01A1 to the author.

A preliminary investigation on potential associations between language tasks and cognitive status

Yuan-Chi Feng¹, Chih-Chin Chan², Hsin-Ju Yang² and Natalie Yu-Hsien Wang^{1*}

¹ Department of Special Education, National Tsing Hua University, Hsinchu, Taiwan

² Department of Audiology and Speech-Language Pathology, Asia University, Taichung, Taiwan

***corresponding author, yh.wang@mx.nthu.edu.tw**

Introduction

Evidence suggests that linguistic features may serve as diagnostic (Galza et al., 2021) or predictive indicators (Eyigoz et al., 2020; Fraser et al., 2019) of Alzheimer's disease. Despite age-related change in the performance of language tasks (e.g. Marini et al., 2005; Gordon & Kurczek, 2014), linguistic features that might assist early detection of abnormal ageing are yet to be identified. In addition, there is a lack of systematic research on language and cognitive aging targeting Mandarin-speaking older adults. Therefore, this study explores the potential of adopting connected speech production and semantic fluency test as tasks for screening abnormal cognitive decline. To achieve this goal, we compared the task performance between young and elderly participants. Further, the potential correlations between task performances and cognitive status were examined.

Methods

Fifteen young (mean age = 21.07 years, $SD = 2.09$) and elderly (mean age = 70.8 years, $SD = 3.89$) participants were recruited for each group. All participants completed a semantic fluency task and a picture description task. The semantic fluency tasks contain three categories, and the final score was the average number of items correctly named within one minute. The cookie-theft picture from Boston Diagnostic Aphasia Examination was used to elicit connected speech, the participants were encouraged to talk as much as possible in order to collect data for around 3 minutes. Mean length of utterance measured in word (MLU-w) was used as an index of speech production performance. Overall cognitive status was evaluated using Mandarin-version Mini-Mental State Examination (MMSE), whilst a computer-based Stroop Color-Word Test (SCWT) was adopted to reflect executive functioning.

To verify the between group difference in each task, paired-sample *t*-tests were applied. Further, Pearson correlation analyses were used to identify potential associations between language and cognitive tasks.

Results

Between group differences were found in MLU-w [$t(28)=2.52$; $p=0.018$], semantic fluency [$t(28)=4.73$; $p<0.001$], MMSE score [$t(28)=2.52$; $p=0.018$], and SCWT test [$t(28)=-2.19$; $p=0.036$], with elderly participants demonstrated larger Stroop effect. The correlation analyses further suggested that MLU-w positively correlated with the MMSE score [$r(28)=0.56$; $p=0.002$] and negatively correlated with the score of Stroop effect [$r(28)=-0.37$; $p=0.042$]. On the other hand, semantic fluency score significantly correlated with the

MMSE score [$r(28) = 0.48$; $p = 0.008$] but not the score of Stroop effect [$r(28) = -0.28$; $p = 0.133$].

Conclusions

The findings of this study support previous evidence that semantic fluency test is sensitive to overall cognitive status. However, the lack of correlation between semantic fluency test and Stroop effect raises the concern that semantic fluency test might not be sensitive enough to detect domain specific cognitive change(s). By contrast, MLU-w significantly correlated with both cognitive measures, demonstrating its potential as a linguistic index of age-related cognitive change. Age-related change in language could start as early as mid-fifty. It is important to establish linguistic indices that reflect various aspects of cognitive function to achieve early identification of abnormal ageing.

References

- Eyigoz, E., Mathur, S., Santamaria, M., Cecchi, G., & Naylor, M. (2020). Linguistic markers predict onset of Alzheimer's disease. *eClinicalMedicine*, 28, 100583.
- Fraser, K. C., Fors, K. L., Eckerström, M., Öhman, F., & Kokkinakis, D. (2019). Predicting MCI status from multimodal language data using cascaded classifiers. *Frontiers in Aging Neuroscience*, 10, 1–18.
- Marini, A., Boewe, A., Caltagirone, C., & Carlomagno, S. (2005). Age-related differences in the production of textual descriptions. *Journal of Psycholinguistic Research*, 34(5), 439–463.
- Gordon, J. K., & Kurczek, J. C. (2014). The ageing neighbourhood: Phonological density in naming. *Language, Cognition and Neuroscience*, 29(3), 326–344.

Acknowledgments

This research was funded by National Science and Technology Council (MOST 111-2410-H-468 -020 -MY3), Taiwan. We would like to thank all the participants for their participation and the speech-language pathologist for referring the cases.

Training word retrieval in aphasia through two semantic feature tasks: a case study

Axel Fernandez Zaionz¹, Leticia Vivas¹, & Daniela Andreotti²

¹ Institute of Basic and Applied Psychology and Technology (IPSIBAT), National University of Mar del Plata - CONICET, Mar del Plata, (Buenos Aires), Argentina.

² San Isidro Central Hospital “Dr. Melchor Ángel Posse”, Buenos Aires, (Buenos Aires), Argentina

*corresponding author, axelfernandezzaionz@mdp.edu.ar

Introduction

Semantic Feature Analysis (SFA) is a therapeutic approach aimed at improving word retrieval by prompting patients to evoke or recognize semantic attributes of concrete nouns or verbs. Empirical studies suggest that SFA is beneficial for individuals with post-stroke aphasia, as it facilitates the activation of semantic networks and improves naming accuracy (Boyle, 2010). In this single-case study, we applied a computerized SFA-based intervention composed of two tasks: one targeting **Evocation of Semantic Features (ESF)** and the other focused on **Recognition of Semantic Features (RSF)**. Stimuli were selected based on Argentinian psycholinguistic norms. The aim was to evaluate the effectiveness of both task modalities on naming trained items and to assess generalization to untrained items.

Methods

Participant: One adult (48 years old) with chronic post-stroke expressive aphasia who had not received therapy during the acute phase. **Design and Procedure:** A single-case experimental ABA design (Kazdin, 2016) was implemented. During baseline (A1), conducted over three sessions, the participant completed a naming task with 80 images from Cykowicz et al. (1997), representing various semantic categories (e.g., mammals, birds, furniture). A subset of 50 items was selected for the intervention phase (B), according to those that participant failed to name in all three baseline attempts. This subset was divided into three lists: ESF (12 items) and RSF (12 items) to assess the effectiveness of each modality, and untrained (26 items) to assess generalization. The intervention consisted of 8 sessions, alternating between ESF and RSF. Naming of trained items was measured immediately after each session. In the post-treatment phase (A2), the full set of 50 items was re-administered to assess treatment effects and generalization. **Data Analysis:** Effectiveness was evaluated following the guidelines by Beeson and Robey (2006) for single-case design. The dependent variable was the proportion of correct responses per session. Effect sizes (d) were calculated using the mean and the pooled standard deviation of both phases (Busk & Serlin, 1992). Performance on untrained items in A2 was examined to assess generalization. Additionally, visual analysis of phase B performance was conducted to explore within-phase trends.

Results

As shown in Figure 1, the RSF condition displayed a progressive upward trajectory, reaching the highest accuracy in A2. Despite this trend, the effect size remained below the

threshold for clinical significance ($d = 2.77$; Table 1) which is ≥ 4 . In contrast, the ESF condition showed greater variability, with a modest improvement in early sessions followed by a sharp decline (notably in Session 8) and an overall low accuracy in A2 ($d = 0.88$; Table 1). No change was observed in the performance of untrained items, suggesting a lack of generalization.

Conclusion

The RSF showed promising effect, even though showing insufficient effect size for clinical significance. While ESF didn't show effect. The high variability in ESF performance may reflect task inefficacy or inherent fluctuations in language performance characteristic of post-stroke aphasia. As suggested by other research (Brady et al., 2022) it is likely that more sessions are needed in order to see a stronger effect.

References

- Beeson, P. M., & Robey, R. R. (2006). Evaluating single-subject treatment research: Lessons learned from the aphasia literature. *Neuropsychology Review*, 16(4), 161–169.
- Boyle, M. (2010). Semantic feature analysis treatment for aphasic word retrieval impairments: What's in a name? *Topics in Stroke Rehabilitation*, 17(6), 411–422.
- Brady, M. C., Ali, M., VandenBerg, K., Williams, L. J., Williams, L. R., Abo, M., Becker, F., Bowen, A., Brandenburg, C., Breitenstein, C., Bruehl, S., Copland, D. A., Cranfill, T. B., di Pietro-Bachmann, M., Enderby, P., Fillingham, J., Galli, F. L., Gandolfi, M., Glize, B., ... Wright, H. H. (2022). Dosage, Intensity, and Frequency of Language Therapy for Aphasia: A Systematic Review-Based, Individual Participant Data Network Meta-Analysis. *Stroke*, 29(2), 956–967.
- Busk, P.L.; Serlin, R. Meta-analysis for single case research. In: Kratochwill, TR.; Levin, JR., editors. *Single-case research design and analysis: New directions for psychology and education*. Lawrence Erlbaum Associates; Hillsdale, NJ: 1992.
- Cycowicz, Y. M., Friedman, D., Rothstein, M., & Snodgrass, J. G. (1997). Picture naming by young children: Norms for name agreement, familiarity, and visual complexity. *Journal of Experimental Child Psychology*, 65(2), 171-237.
- Kazdin, AE (2016). Diseños de investigación experimental de caso único. En AE Kazdin (Ed.), *Cuestiones metodológicas y estrategias en la investigación clínica* (págs.459–483). APA

Acknowledgments

This work is part of a doctoral fellowship from the National Scientific and Technical Research Council (CONICET) and was carried out at the Institute of Basic and Applied Psychology and Technology (IPSIBAT) of the National University of Mar del Plata (UNMDP)

Figure 1. Accuracy Over Time by Condition

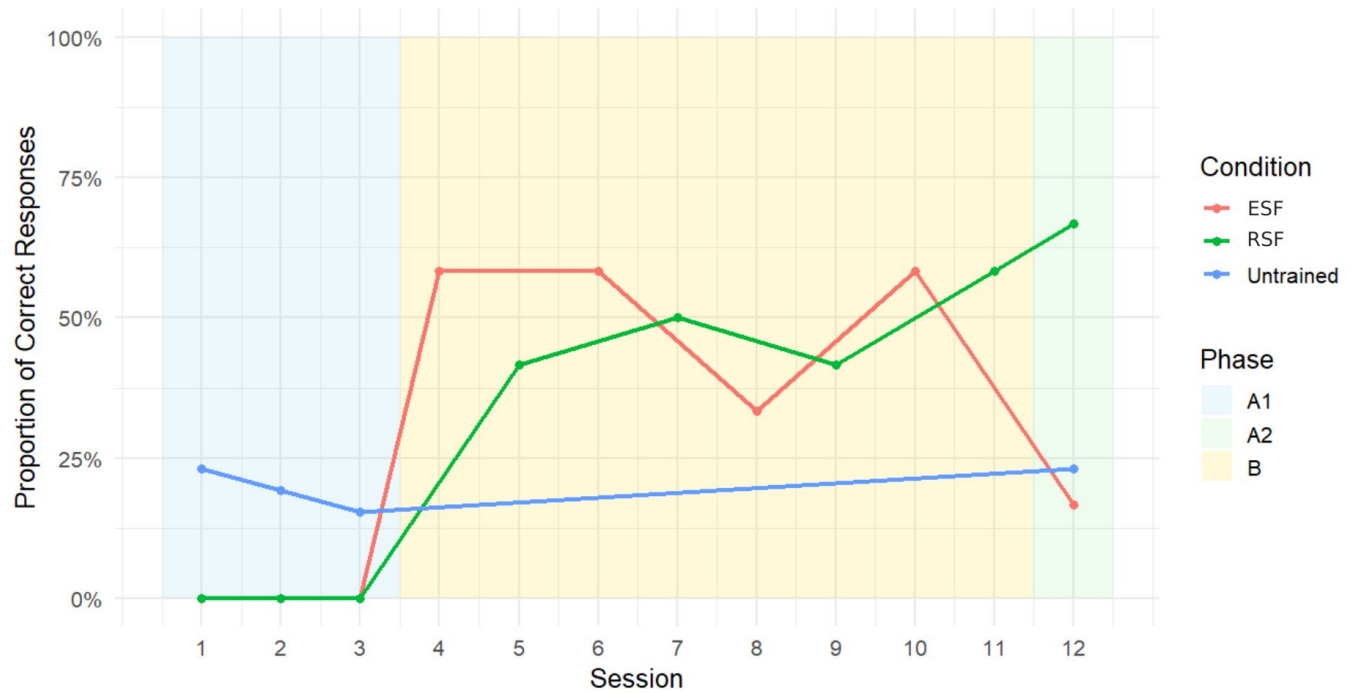


Table 1. Effect sizes (d) by condition (Beeson & Robey, 2006 criteria)

Condition	Phase A2 Mean	Phase A2 SD	d.	Interpretation
ESF	.17	.39	.88	not significant
RSF	.67	.49	2.77	very small
Untrained	.23	.42	.09	not significant

Constructing Multimodal Bilingual Input: Crosslinguistic Interactions in Text and Image Combinations

Laura P. Fitzgerald¹, Jaime Antoshak¹, Jennifer Simpson¹, Giuseppina Hazen¹, Erica Axtell², Paula Ledesma², Tobias Kuhlmeier², Ainsley Perez², Leyla Galindo², Stephanie Riès², Henrike Blumenfeld^{2*}

¹ Department of Linguistics and Asian/Middle Eastern Languages, San Diego State University, San Diego, CA, USA

² School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, CA, USA

*corresponding author, hblumenf@sdsu.edu

Introduction

Bilinguals activate their languages in parallel (Grosjean, 1989), enabling faster, more accurate retrieval of cognates (words with phonological, orthographic, and semantic overlap; e.g., *tigre* [Spanish], *tiger* [English]) than noncognates (Van Heuven et al., 1998). While this facilitatory cognate effect is well-documented (e.g., Costa et al., 2005; Dijkstra et al., 1998), cognate effects vary across studies in younger bilinguals, older bilinguals, and bilinguals with aphasia (Blumenfeld et al., 2020). Better understanding of this variability may support planning of crosslinguistic generalization effects in cognate-based bilingual aphasia intervention. Furthermore, while prior research examining cognate effects has typically used single sources of input (e.g., isolated text/images), real-world contexts often provide multiple input sources. Use of multimodal input must be examined, as stimulus type may contribute to variation in cognate effects (Schwartz & Kroll, 2006; Titone et al., 2011; Van Hell & De Groot, 2008). We manipulated the cognate status within image-text pairings in two studies.

Methods – STUDY 1

Forty Spanish-English bilinguals (ages 18-40, see Table 1) completed a Spanish picture-word matching task in which they saw images with a written word superimposed and judged whether the image matched the text. Cognate status (cognate/noncognate) was modulated in both the image and text dimensions. There were six conditions: four unrelated conditions with mismatched image-text pairings, and two identity conditions where the image and text matched. The four unrelated conditions had the following combinations: Cognate-Cognate (e.g., image=*calendario* [calendar], text=*tigre* [tiger]); Noncognate-Noncognate (e.g., image=*perro* [dog], text=*bote* [can]); Noncognate-Cognate; Cognate-Noncognate.

We PREDICTED faster and more accurate responses for cognate than noncognate stimuli for both text and images, with possible interactions between stimulus-presentation dimensions.

Results – STUDY 1

We FOUND a main effect of cognate status on reaction times (RTs) for both dimensions. Responses were faster for cognate than noncognate text ($p=.002$), but slower for cognate

than noncognate images ($p=.02$). We also observed a cognate status-stimulus dimension interaction: RTs were slowest for noncognate text paired with cognate images ($p<.001$, see Figure 1). These findings SUGGEST greater word-retrieval difficulty when sources of input diverge in cognate status, particularly when images promote parallel language activation but text does not.

Methods – STUDY 2

In STUDY 2, we aim to examine visual attention allotted to text versus image separately to better isolate processing of each. We incorporate eye-tracking, presenting text and images in separate quadrants of a screen. Based on Study 1 findings, we PREDICT longer fixation durations in the divergent (noncognate image+cognate text/cognate image+noncognate text) conditions than the convergent conditions, reflecting more sustained processing focus (Demberg & Keller, 2008) when one input source promotes parallel activation while the other is language-selective.

Results – STUDY 2

In STUDY 2 PILOT DATA ($n=12$), fixation duration differences emerged in the divergent conditions: fixations were shorter for cognate than noncognate images (Cohen's $d=0.28$) and for cognate than noncognate text ($d=0.25$), suggesting greater processing load for noncognate input when only one dimension promotes parallel activation. Fixation start times were later for noncognate than cognate images ($d=0.76$) and text ($d=0.47$) in divergent trials, indicating more returns to noncognate stimuli, suggesting less certainty (Castelhano & Rayner, 2008).

Conclusion

Current findings IMPLY careful consideration of cognate and noncognate content is warranted in research and clinical settings. The context in which cognates are presented may influence the extent of crosslinguistic effects in bilingual aphasia intervention.

References

- Blumenfeld, H.K., Robinson Anthony, J.J.D, Neely, B, Nguyen, C., Kim, A., & Ries, S.K. (2020, October). The crosslinguistic cognate effect in bilinguals across the lifespan: A systematic review. The 58th Annual Academy of Aphasia Meeting. Philadelphia, PA [virtual due to COVID-19 restrictions].
- Castelhano, M. S., & Rayner, K. (2008). Eye movements during reading, visual search, and scene perception: An overview. In K. Rayner, D. Shen, X. Bai, & G. Yan (Eds.), *Cognitive and cultural influences on eye movements* (pp. 3–33). Tianjin People's Publishing House.
- Costa, A., Santesteban, M., & Caño, A. (2005). On the facilitatory effects of cognate words in bilingual speech production. *Brain and Language*, 94(1), 94-103.
- Demberg, V., & Keller, F. (2008). Data from eye-tracking corpora as evidence for theories of syntactic processing complexity. *Cognition*, 109(2), 193-210.
- Dijkstra, T., Van Heuven, W. J. B. & Grainger, J. (1998). Simulating cross-language competition with the bilingual interactive activation model. *Psychologica Belgica*, 38(3/4), 177–196.

- Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain and Language*, 36(1), 3–15.
- Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing Language Profiles in Bilinguals and Multilinguals. *Journal of Speech, Language, and Hearing Research*, 50(1), 940-967.
- Schwartz, A. I., & Kroll, J. F. (2006). Bilingual lexical activation in sentence context. *Journal of Memory and Language*, 55(2), 197-212.
- Titone, D., Libben, M., Mercier, J., Whitford, V., & Pivneva, I. (2011). Bilingual lexical access during L1 sentence reading: The effects of L2 knowledge, semantic constraint, and L1–L2 intermixing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 37(6), 1412.
- Van Hell, J. G., & De Groot, A. M. (2008). Sentence context modulates visual word recognition and translation in bilinguals. *Acta Psychologica*, 128(3), 431-451.
- Van Heuven, W. J., Dijkstra, T., & Grainger, J. (1998). Orthographic neighborhood effects in bilingual word recognition. *Journal of Memory and Language*, 39(3), 458-483.

Acknowledgments

The authors would like to thank the former members of the Bilingualism and Cognition Laboratory who contributed to this project, including Mary Hernandez, Jonathan Robinson Anthony, and Emma Hodge, as well as the collaborating members of the Laboratory for the Brain Dynamics of Language. This research was funded by an award to HB from the San Diego State University Grant Program.

Figure 1. Effects of cognate / noncognate status on reaction times in the text and image stimulus dimensions. A significant interaction effect reveals shorter reaction times when both text and image are cognates or when both text and image are noncognates (convergent pairings).

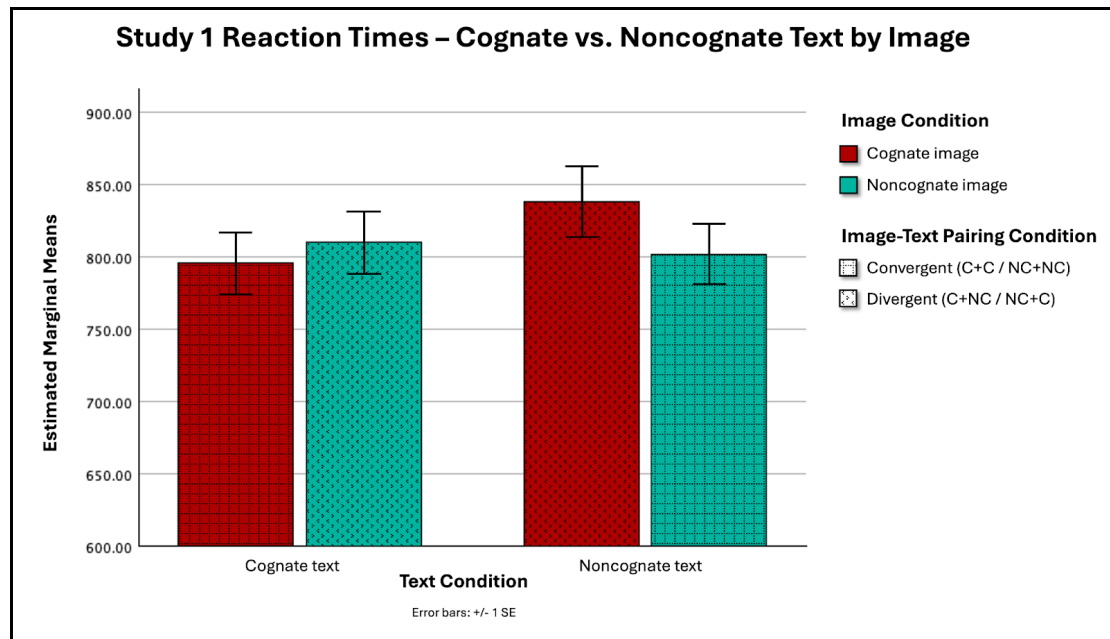


Table 1. Participants' language backgrounds and experiences based on responses to the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian et al., 2007). The participants were younger adults (STUDY 1: M age = 25.02, SD = 4.47, range = 18-34; STUDY 2: M age = 22.67, SD = 2.74, range = 20-28), most of whom had some post-secondary education (STUDY 1: M years of education = 17.67, SD = 3.44, range = 11-32; STUDY 2: M years of education = 16.67, SD = 1.87, range = 14-20).

Language Experience and Proficiency Questionnaire (LEAP-Q) Responses				
STUDY 1 N = 40	<i>Spanish</i>		<i>English</i>	
	Mean (SD)	Range	Mean (SD)	Range
Age of Acquisition	2.75 (4.63)	0-15	3.88 (4.27)	0-26
Age of Fluency	6.83 (6.71)	1-22	6.96 (4.90)	1-28
Years of Family Exposure	19.33 (10.18)	0-34	15.09 (10.67)	0-34
Years of School Exposure	6.44 (7.32)	0-25	15.61 (5.33)	0-25
Self-Reported Proficiency (0-10)	8.32 (1.10)	6.33-10	9.50 (0.96)	6.33-10
Self-Reported Exposure (%)	34.61 (16.15)	1.0-80.0	65.41 (15.08)	35-100

STUDY 2 <i>N</i> = 12	Spanish		English	
	Mean (SD)	Range	Mean (SD)	Range
Age of Acquisition	0.5 (1.0)	0-3	2.17 (2.21)	0-6
Age of Fluency	3.92 (3.15)	2-13	5.25 (2.34)	2-10
Years of Family Exposure	21.01 (7.11)	0-28	16.92 (10.47)	0-28
Years of School Exposure	11.0 (8.95)	0-25	19.67 (3.45)	15-28
Self-Reported Proficiency (0-10)	8.31 (1.05)	5.67-9.33	9.22 (0.82)	7.67-10
Self-Reported Exposure (%)	40.0 (19.42)	5.0-80.0	58.75 (22.47)	5-85

Exploring an Acoustic Metric for Differential Diagnosis of Apraxia of Speech

Mikala Fleegle^{1*}, Marianne Casilio², Stacey Steel¹, Courtney McCoy¹, and Gerasimos Fergadiotis¹

¹ Speech and Hearing Sciences, Portland State University, Portland, OR, USA

² Hearing and Speech Sciences, Vanderbilt University, Nashville, TN, USA

*corresponding author, soroka@pdx.edu

Introduction

Differential diagnosis of apraxia of speech (AOS) is difficult due to its co-occurrence and symptom overlap with aphasia and dysarthria, and because performance often varies with task complexity (e.g., Duffy, 2013). Prior work has shown that an acoustic measure of vowel duration—the pairwise variability index (PVI)—is sensitive to AOS in the presence of aphasia (Ballard et al., 2016; Basilakos et al., 2017; Vergis et al., 2014). However, the generalizability of these findings is limited by (a) the use of multiple, varied stimuli to derive PVI and (b) the absence of benchmarking performance relative to diagnostic- and task-specific confounds.

The present study explores the utility of PVI, elicited using a single stimulus, for differential diagnosis of AOS in stroke survivors with aphasia. Our question was: Is PVI uniquely associated with (a) AOS and (b) features salient to motor speech disorders in connected speech?

Methods

Fifty participants with chronic post-stroke aphasia were recruited as part of an ongoing study on anomia assessment (Hula et al., 2025; Table 1). A speech-language pathologist made binary judgments of AOS and dysarthria using all available testing and quantified aphasia severity using an established battery (Swinburn et al., 2004).

Audio recordings of word repetition (*banana* 3x) and Cinderella retell tasks were used to calculate PVI and connected speech metrics, respectively. PVI was measured using Praat (Boersma & Weenink, 2023) following a predefined protocol (Ballard et al., 2016), where lower PVI values indicate less contrast between vowel durations (more equal stress). Paraphasia, Logopenia, Agrammatism, and Motor speech dimensions were scored using an auditory-perceptual approach (Casilio et al., 2019).

PVI was modeled as a function of relevant diagnostic or connected speech predictors using fixed effects regression.

Results

There was a significant negative effect of AOS ($p < .001$) and dysarthria ($p < .001$) diagnoses, each accounting for ~13% of the unique variability in PVI (Figure 1A). Lower PVI was associated with the presence of AOS and dysarthria. Aphasia severity had no significant effect ($p = .26$).

There were significant negative effects for all but the Paraphasia dimension of connected speech ($p < .17$) (Figure 1B). Motor speech ($p < .001$) and Agrammatism ($p = .004$) accounted for ~21% and ~10% of variability in PVI, respectively. Lower PVI was associated with

greater impairment. Logopenia ($p = .01$) accounted for ~7% unique variability but had a positive association.

Conclusions

PVI derived from a single stimulus is uniquely associated with AOS and dysarthria but not aphasia. This pattern was scalable to connected speech, where the Motor speech dimension (encompassing both AOS and dysarthria features) was most strongly associated with PVI. Two other dimensions of nonfluency (Logopenia, Agrammatism) were also associated with PVI, however, highlighting the challenge of quantifying linguistic versus motoric impairments in contextualized speech (Casilio et al., 2019).

PVI may be a useful metric for differentially diagnosing AOS in the absence of dysarthria, which is rarely persistent in post-stroke aphasia (Wilson et al., 2023). Future research is needed to evaluate the utility of various stimuli and to automate PVI extraction in support of clinical implementation.

References

- Ballard, K. J., Azizi, L., Duffy, J. R., McNeil, M. R., Halaki, M., O'Dwyer, N., Layfield, C., Scholl, D. I., Vogel, A. P., & Robin, D. A. (2016). A predictive model for diagnosing stroke-related apraxia of speech. *Neuropsychologia*, 81, 129–139.
- Basilakos, A., Yourganov, G., den Ouden, D.B., Fogerty, D., Rorden, C., Feenaughty, L., & Fridriksson, J. (2017). A multivariate analytic approach to the differential diagnosis of apraxia of speech. *Journal of Speech, Language, and Hearing Research*, 60(12), 3378–3392.
- Boersma, P. & Weenink, D. (2023). Praat: Doing phonetics by computer [Computer program]. Version 6.3.16, retrieved 29 August 2023 from <http://www.praat.org/>
- Casilio, M., Rising, K., Beeson, P. M., Bunton, K., & Wilson, S. M. (2019). Auditory-perceptual rating of connected speech in aphasia. *American Journal of Speech-Language Pathology*, 28(2), 550–568.
- Duffy, J. R. (2013). *Motor speech disorders: Substrates, differential diagnosis, and management*. (3rd ed.). Elsevier Mosby.
- Hula, W., Nunn, K., Swiderski, A., Nicholson, H., Steel, S., Ranian, C., Babiak, M., & Fergadiotis, G. (2025, May). *Cross-walking commonly used picture naming tests for aphasia*. Talk presented at the Clinical Aphasiology Conference in Albuquerque, NM.
- Swinburn, K., Porter, G., & Howard, D. (2004). *Comprehensive Aphasia Test*. Psychological Corporation.
- Vergis, M., Ballard, K. J., Duffy, J. R., McNeil, M. R., Scholl, D., & Layfield, C. (2014). An acoustic measure of lexical stress differentiates aphasia and aphasia plus apraxia of speech after stroke. *Aphasiology*, 28(5), 554–575.
- Wilson, S. M., Entrup, J. L., Schneck, S. M., Onuscheck, C. F., Levy, D. F., Rahman, M., ... & Kirshner, H. S. (2023). Recovery from aphasia in the first year after stroke. *Brain*, 146(3), 1021–1039.

Acknowledgments

We thank the many participants who took the time and energy to participate in this research project. This research was supported in part by NIH grants awarded to author G.

F.: R21DC021239 and R01DC018813, as well as a Portland State University Faculty Enhancement Grant awarded to author M. F.

Figure 1. Main study findings. Forest plots from the models aimed at investigating **(A)** diagnostic predictors and **(B)** connected speech predictors. The circles depict the raw beta coefficient, which is printed above each, and the lines show the 95% confidence interval. The black vertical bar reflects the point of statistical significance for the coefficients. *=significant at $p<.05$; **=significant at $p<.01$; ***=significant at $p<.001$

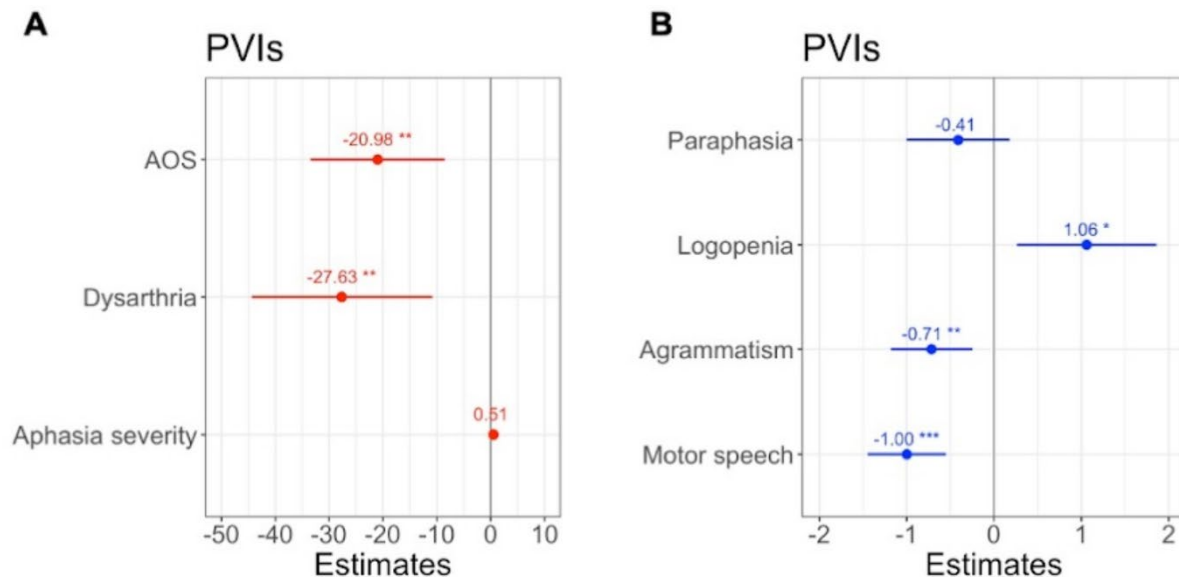


Table 1. Participant demographics and clinical characteristics

Characteristic	Value
Age in years, mean, (SD), min-max	60.54 (12.71), 26–82
Sex	
Male	30 (60%)
Female	20 (40%)
Race	
White	46 (92%)
Black or African American	2 (4%)
Asian	1 (2%)
Native Hawaiian or Other Pacific Islander	1 (2%)
Education in years, mean, (SD), min-max	16.4 (3.14), 9–24
High School	10 (20%)
Associate's Degree	4 (8%)
Trade School	2 (4%)
College Graduate	17 (34%)
Master's Degree	10 (20%)
Doctorate	6 (12%)
Time post-onset in months, median, (SD), min-max	41.5 (61.16), 6–257
CAT modality mean <i>t</i> score, mean, (SD), min-max	56.24 (6.55) 41.17–66.33
Motor Speech Disorder	
None	29 (58%)
AOS	14 (28%)
Dysarthria	2 (4%)
Both AOS and Dysarthria	5 (10%)
PVI, median, (SD), min-max	91.14 (25.38), 20.84–136.67
APROCSA dimension score, mean, (SD), min-max	
Paraphasia	20.72 (14.99), 2.78–66.67
Logopenia	32.88 (19.68), 9.38–87.5
Agrammatism	13.36 (16.61), -7.14–82.14
Motor speech	28.4 (24.79), 0–100

Note. Higher scores on the CAT indicate less impairment. PVI was calculated as the absolute value difference between first and second vowel durations divided by their average, then multiplied by 100. Higher PVI values indicate greater contrast between vowel durations (varied prosody). Higher scores on APROCSA indicate greater impairment. AOS = apraxia of speech; APROCSA = auditory-perceptual rating of connected speech in aphasia; CAT = Comprehensive Aphasia Test; PVI = Pairwise Variability Index; SD = standard deviation; min = minimum; max = maximum.

Classification of lexical retrieval impairments in Primary Progressive Aphasia

Naama Friedmann¹, Ophir Keret², Amir Glik², and Yuval Z. Katz^{1*}

¹Language and Brain Lab, Tel Aviv University, Tel Aviv, Israel

²Cognitive Neurology Clinic, Department of Neurology, Rabin Medical Center, Petah Tikva, Israel

*corresponding author, yuvalk1@mail.tau.ac.il

Introduction

Lexical retrieval impairments are a hallmark feature of Primary Progressive Aphasia (PPA) and play a central role in diagnosis and clinical management. Most research on lexical retrieval in PPA categorizes deficits only broadly as either semantic or phonological, without identifying the exact functional locus of impairment or accounting for finer dissociations within these categories. The cognitive neuropsychological literature recognizes lexical retrieval as a multi-staged process that involves several distinct cognitive components: the conceptual system, which encodes the speaker's intended message in the form of pre-linguistic mental representations; the semantic lexicon, which stores abstract entries organized by meaning; the phonological output lexicon, which contains phonological forms, and the phonological output buffer, a short-term memory system that assembles, maintains, and sequences phonemes and morphemes prior to articulation.

Research on other neurological conditions, such as post-stroke aphasia, has demonstrated that each of these stages can be selectively impaired, resulting in characteristic patterns of symptoms (Friedmann et al., 2013; Howard & Gatehouse, 2006; Kay et al., 1996; Nickels, 1995, 1997). The current study applies a cognitive neuropsychological model of lexical retrieval and a corresponding classification framework to systematically categorize lexical retrieval impairments in Hebrew-speaking individuals with PPA.

Methods

We examined 40 Hebrew-speaking participants with PPA, who completed a comprehensive assessment battery including picture naming, object knowledge (picture association), single-word comprehension (word-picture matching), surface dyslexia screening, and nonword repetition. To ensure consistent diagnosis, we developed and applied an algorithm for classifying the functional locus of impairment (Figure 1). The algorithm is based on the cognitive neuropsychological stages of lexical retrieval and incorporates both task performance and error types.

Results

Of the 40 participants, 30 (75%) exhibited lexical retrieval impairments, while 10 (25%) demonstrated spared lexical retrieval abilities. Among those with impairments, 13 participants had a deficit in a single cognitive component, 9 had impairments in two components, and 8 had impairments in three components. All types of lexical retrieval impairments and all possible combinations were identified.

Each type of impairment was associated with a distinct profile of errors across tasks. Conceptual impairments led to unrelated substitutions, distant semantic errors, and impaired object recognition. Semantic lexicon deficits were marked by semantic errors in naming, impaired word comprehension, and preserved object knowledge. Participants with impairments in the phonological output lexicon or its access from the semantic lexicon showed long hesitations, self-corrected semantic substitutions, phonological errors, and, in cases of an impairment to the lexicon itself, surface dyslexia. Phonological output buffer impairments resulted in phonemic and morphological errors accompanied by impaired nonword repetition.

Conclusions

This study highlights the value of a theory-driven approach to classifying lexical retrieval impairments in PPA. Through diverse tasks and error analysis, it enables precise diagnosis and can guide tailored interventions. For example, distinguishing between conceptual and semantic deficits may indicate whether non-linguistic communication will be an effective strategy. Beyond its clinical utility, this approach also offers an opportunity to further investigate the structure and organization of lexical retrieval by examining the distinct ways in which this process can break down in PPA.

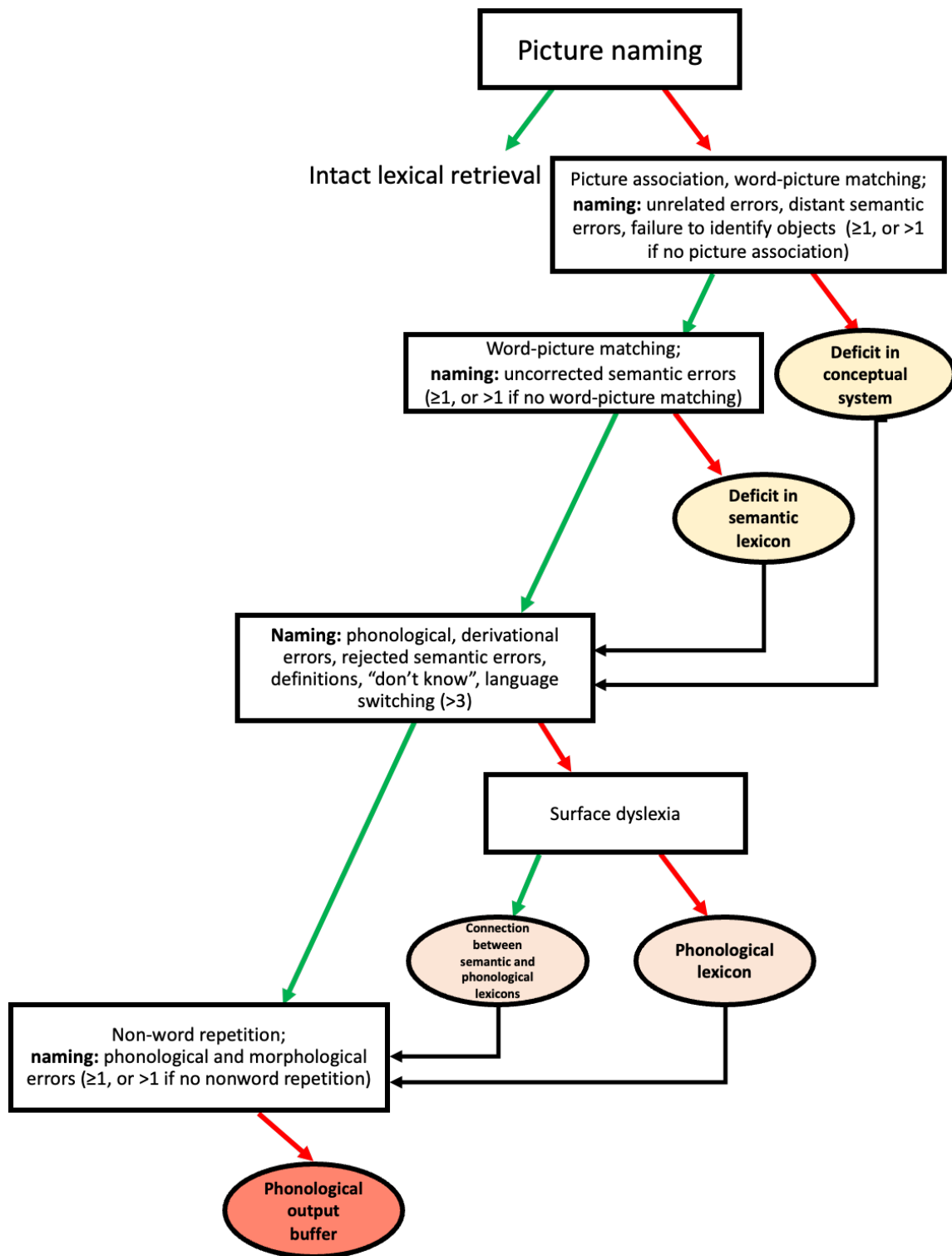
References

- Friedmann, N., Biran, M., & Dotan, D. (2013). Lexical retrieval and breakdown in aphasia and developmental language impairment. In C. Boeckx & K. K. Grohmann (Eds.), *The Cambridge Handbook of Bilingualism* (pp. 350-374). Cambridge University Press.
- Howard, D., & Gatehouse, C. (2006). Distinguishing semantic and lexical word retrieval deficits in people with aphasia. *Aphasiology*, 20(9), 921–950.
- Kay, J., Lesser, R., & Coltheart, M. (1996). Psycholinguistic assessments of language processing in aphasia (PALPA): An introduction. *Aphasiology*, 10(2), 159–180.
- Nickels, L. (1995). Getting it right? Using aphasic naming errors to evaluate theoretical models of spoken word recognition. *Language and Cognitive Processes*, 10(1), 13–45.
- Nickels, L. (1997). *Spoken word production and its breakdown in aphasia*. Psychology Press.

Acknowledgments

We thank the participants in the study.

Figure 1. An algorithm for determining the functional impairment in lexical retrieval.



Girdle' for 'guardrail' and 'batch' for 'match': Formal paraphasia involving phonemically related real words is closely related to phonemic paraphasia

Michitaka Funayama^{1,2,3*}, Yoshitaka Nakagawa²

1 Department of Neuropsychiatry, Ashikaga Red Cross Hospital, Ashikaga, Japan

2 Department of Rehabilitation, Edogawa Hospital, Tokyo, Japan

3 Department of Neuropsychiatry, Keio University School of Medicine, Tokyo, Japan

***corresponding author, mctkfnym@gmail.com**

Introduction

Formal paraphasia, phonemically related yet incorrect real words, such as 'biscuits' for 'baskets', has been described for decades, yet the underlying mechanisms not been fully elucidated and the associated neural basis remains unclear. Therefore, we explored the underlying mechanisms and neural substrate of formal paraphasia.

Methods

A total of 57 aphasia patients who had suffered from cerebrovascular disease were recruited. Results from the picture-naming test in the Test of Lexical Processing in Aphasia allowed classification of the paraphasias into subtypes, e.g., formal paraphasia, phonemic paraphasia, and relevant paraphasia. Multiple linear regression analysis was used to identify which paraphasia subtype is associated with the development of formal paraphasia. Factor analysis was also used to simplify paraphasia data to define the underlying mechanism. Voxel-based lesion-symptom mapping was performed using MRICron software to explore the neuroanatomical substrate for formal paraphasia.

Results

The multiple linear regression analysis revealed that the number of formal paraphasia correlated positively with the number of phonemic paraphasias but not with the other variables. The results of the factor analysis reinforced the close relation between formal and phonemic paraphasias. The white matter underlying the superior temporal gyrus and the left supramarginal gyrus as well as the middle temporal gyrus were found to underlie the development of formal paraphasia.

Conclusions

Our results reveal that formal paraphasia is closely related to phonemic paraphasia in terms of both the mechanism and neural substrate, suggesting that formal paraphasia is caused mainly by phonemic substitution.

Neural correlates of non-linguistic cognitive control in left hemisphere stroke survivors

Andrea F. Gálvez-McDonough^{1,2*}, Yusheng Wang^{1,2}, Peter E. Turkeltaub^{3,4}, and Stéphanie K. Riès^{1,2,5}

¹SDSU/UCSD Joint Doctoral Program in Language and Communicative Disorders

²School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, (California), United States

³Center for Brain Plasticity and Recovery, Georgetown University Medical Center, Washington, (D.C.), United States

⁴Research Division, MedStar National Rehabilitation Hospital, Washington, (D.C.), United States

⁵Center for Clinical and Cognitive Neuroscience, San Diego State University, San Diego, (California), United States

*corresponding author, agalvezmcdonou2526@sdsu.edu

Introduction

While most studies in left hemisphere stroke survivors tend to focus on deficits in linguistic abilities and their underlying processes following impairment, some studies have also suggested deficits in domain-general executive functions (e.g. Dekhtyar et al., 2020, Farooqi-Shah et al., 2018). In the current study we examined the relationship between nonlinguistic cognitive control abilities and the integrity of white matter tracts of interest in left hemisphere stroke survivors.

Methods

We assessed nonlinguistic cognitive control abilities in 98 left hemisphere stroke survivors through their performance in a Simon task (Simon, 1990). In this task participants were presented with either a red or blue flash in one of two side-by-side squares at the top of a touchscreen laptop. Below the squares was a response button with a red square on one side and a blue square on the other. In a given trial, participants were asked to indicate the color of the flash by manually selecting the appropriate colored square as quickly as possible while ignoring the location of the stimulus. Diffusion weighted images were collected in 92 of these participants. We used DSI Studio (<https://dsi-studio.labsolver.org/>) to generate tractograms and apply the DTI matrix. Auto-segmentation was used to obtain the tracts of interest (arcuate fasciculus, frontal aslant tract, superior longitudinal fasciculus, uncinate fasciculus, and corticostriatal connections) and their corresponding measures of white matter integrity (FA and MD). Data processing is ongoing and has been completed for 67 of the 92 participants with available diffusion weighted images.

Results

Preliminary findings ($n = 67$) show significant effects of Condition on both Accuracy (Wald $\chi^2(1) = 15.41$, $p < .001$) and Reaction Times (Wald $\chi^2(1) = 68.78$, $p < .001$). Participants were less accurate ($\beta_{\text{raw}} = -.413$, $SE = .105$, $z = -3.93$, $p < .001$) and slower ($\beta_{\text{raw}} = .015$, $SE = .002$, $t = 8.30$, $p < .001$) in their responses to incongruent relative to

congruent trials. Partial correlation analyses, controlling for effects of lesion volume and aphasia severity, revealed a significant positive association between structural integrity of the left uncinate fasciculus (UF) and the effect of condition on reaction times ($r(38) = .405$, $p = .012$).

Conclusions

Structural integrity of the UF has previously been implicated in the mediation of semantic control during word comprehension (Harvey et al., 2013). Greater structural integrity of the right UF has also been associated with better performance in executive functions (Sasson et al., 2013). The preliminary evidence presented here suggests that the left UF is not only important for semantic control but also in domain-general cognitive control, as is involved in the Simon task.

References

- Dekhtyar, M., Kiran, S., & Gray, T. (2020). Is bilingualism protective for adults with aphasia?. *Neuropsychologia*, 139, 107355.
- Faroqi-Shah, Y., Sampson, M., Pranger, M., & Baughman, S. (2018). Cognitive control, word retrieval and bilingual aphasia: Is there a relationship?. *Journal of Neurolinguistics*, 45, 95-109.
- Harvey, D. Y., Wei, T., Ellmore, T. M., Hamilton, A. C., & Schnur, T. T. (2013). Neuropsychological evidence for the functional role of the uncinate fasciculus in semantic control. *Neuropsychologia*, 51(5), 789-801.
- Sasson, E., Doniger, G. M., Pasternak, O., Tarrasch, R., & Assaf, Y. (2013). White matter correlates of cognitive domains in normal aging with diffusion tensor imaging. *Frontiers in neuroscience*, 7, 32.
- Simon, J. R. (1990). The effects of an irrelevant directional cue on human information processing. In *Advances in psychology* (Vol. 65, pp. 31-86). North-Holland.

Acknowledgements

This work was partially supported by an NIH training grant T32 DC007361-17 to AFGM.

State-of-the-art analyses of fluency tasks in healthy and neurological populations

Logan Gaudet^{1,2,3}, Jet M.J. Vonk^{4,5}, Jeffrey C. Zemla⁶, Adrià Rofes^{*1,2},

¹Center for Language and Cognition, University of Groningen, The Netherlands;

²Research School of Behavioral and Cognitive Neurosciences, University of Groningen, The Netherlands;

³Paris Brain Institute, Sorbonne University, France;

⁴Memory and Aging Center, University of California San Francisco, USA;

⁵Julius Center for Health Sciences and Primary Care, Utrecht University, The Netherlands;

⁶Department of Psychology, Syracuse University, USA.

***Corresponding author, a.rofes@rug.nl**

Introduction

Fluency tasks require participants to produce as many words as possible belonging to a specific category (e.g., animals) or starting with a specific letter (e.g., F)^{1,2}. The total number of correct words produced in one or two minutes can help us classify people with vs without language impairments^{2,3}. To understand language impairments in depth, additional measures have been proposed. In this symposium, we will discuss state-of-the-art analyses of fluency tasks in healthy and neurological populations. We will focus on how people group words⁴⁻⁶ (clusters, switches, network metrics); the characteristics of the words produced⁵⁻⁷ (item-level analyses including frequency, concreteness...); and relations between total number of words as well as item-level metrics with other cognitive tests and neuroimaging measures⁸. We will showcase novel approaches that use graph theory⁵⁻⁶, computational linguistics⁹, machine learning⁶⁻⁷, neuroimaging¹⁰⁻¹¹ and epidemiological methods¹²⁻¹³.

Structure

Session 1 – Correct words, switches and clusters (Logan Gaudet)

Total number of correct words of fluency tasks can be used to study the integration of multiple cognitive mechanisms. However, sequence-level patterns such as clustering and switching shed light on the distinct processes underlying efficient and strategic lexical search. Advancements in computational extraction of these measures have improved their clinical applicability. Recent research examines their neural correlates in brain tumor patients, offering deeper insights into language function beyond total word output.

Session 2 – Word embeddings and semantic representations (Jeffrey C. Zemla)

Word embedding models (e.g., word2vec, BERT) are commonly used to estimate word pair similarity, but these embeddings are not optimized for modeling memory retrieval or mental associations. However, fluency data can be used to fine-tune these embeddings. This process allows one to estimate and compare semantic representations of neurological populations (e.g., Alzheimer's disease), and to augment traditional clustering and switching analyses.

Session 3 – Item-level analyses (Adrià Rofes)

The frequency, concreteness, and other characteristics of the correct words produced in animal fluency can be used to classify Primary Progressive Aphasia variants, and also to assess underlying lexico-semantic difficulties in people with Alzheimer's disease, Parkinson's disease (before and after surgery), and HIV without dementia.

Session 4 – Cognition, neuroimaging, and epidemiology (Jet M.J. Vonk)

Large-scale datasets help determine the utility of verbal fluency tasks as sensitive markers of neurodegenerative disease progression by analyzing total scores and item-level metrics in relation to cognition and neuroimaging. Epidemiological methods, including longitudinal modeling and sociodemographic effects in cohort data, allow for the assessment of fluency performance as an indicator of broader cognitive decline and neural changes over time.

Interest to the Academy

Fluency tasks are commonly used in research and clinical practice. The current advent of studies discussing new approaches to analyze these tasks has not been reviewed in this conference. New analyses of fluency tasks provide ways to understand the underlying language impairments of multiple neurological populations, using tasks that are unencumbered by external stimuli, and that are easy to score and to administer.

Selected References

- [1] Bousfield, W. A., & Sedgewick, C. H. W. (1944). An Analysis of Sequences of Restricted Associative Responses. *The Journal of General Psychology*, 30(2), 149-165. doi:10.1080/00221309.1944.10544467
- [2] Rosen, W. G. (1980). Verbal fluency in aging and dementia. *Journal of Clinical Neuropsychology*, 2(2), 135–146. doi:10.1080/01688638008403788
- [3] Gaudet, L., Rybka, L., Mandonnet, E., Volle, E., Barberis, M., Jonkers, R., & Rofes, A. (2024). Leveraging relatedness-based measures in people with language disorders: a scoping review. *Journal of Neuropsychology, on-line first*. doi: 10.1111/jnp.12405.
- [4] Troyer, A. K., Moscovitch, M., Winocur, G., Leach, L., & Freedman, and M. (1998). Clustering and switching on verbal fluency tests in Alzheimer's and Parkinson's disease. *Journal of the International Neuropsychological Society*, 4(2), 137–143. doi:10.1017/S1355617798001374
- [5] Zemla, J. C., & Austerweil, J. L. (2018). Estimating semantic networks of groups and individuals from fluency data. *Computational brain & behavior*, 1, 36-58. doi:10.1007/s42113-018-0003-7
- [6] Zemla, J. C., Cao, K., Mueller, K. D., & Austerweil, J. L. (2020). SNAFU: The semantic network and fluency utility. *Behavior research methods*, 52, 1681-1699. doi:10.3758/s13428-019-01343-w
- [5] De Marco, M., Vonk, J. M., & Quaranta, D. (2023). The mechanistic and clinical principles of item-level scoring methods applied to the category fluency test and other tests of semantic memory. *Frontiers in psychology*, 14, 1152574. doi:10.3389/fpsyg.2023.1152574
- [6] Rofes, A., Beran, M., Jonkers, R., Geerlings, M.I., Vonk, J.M.J. (2023). What drives task performance in animal fluency in individuals without dementia? The SMART-

- MR study. *Journal of Speech, Language, and Hearing Research (ASHA)*, 66(9), 3473-3485. doi:10.1044/2023_JSLHR-22-00445
- [7] Rofes, A., de Aguiar, V., Jonkers, R., Oh, S.J., Dede, G., & Sung, J.E. (2020). What drives task performance during animal fluency in people with Alzheimer's disease? *Frontiers in Psychology*, 11, 1485-1496. doi:10.3389/fpsyg.2020.01485
- [8] Vonk, J. M., Rizvi, B., Lao, P. J., Budge, M., Manly, J. J., Mayeux, R., & Brickman, A. M. (2019). Letter and category fluency performance correlates with distinct patterns of cortical thickness in older adults. *Cerebral Cortex*, 29(6), 2694-2700. doi:10.1093/cercor/bhy138
- [9] Zemla, J., & Castro, N. (2025). Fine-tuning Semantic Vectors With Semantic Fluency Data. OSF. https://osf.io/ytqcx_v1/download
- [10] Vonk, J. M. J., Bouteloup, V., Mangin, J. F., Dubois, B., Blanc, F., Gabelle, A., ... & on behalf of the MEMENTO cohort Study Group. (2020). Semantic loss marks early Alzheimer's disease-related neurodegeneration in older adults without dementia. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring*, 12(1), e12066. doi:10.1002/dad2.12066
- [11] Vonk, J. M. J., Rizvi, B., Lao, P. J., Budge, M., Manly, J. J., Mayeux, R., & Brickman, A. M. (2019). Letter and category fluency performance correlates with distinct patterns of cortical thickness in older adults. *Cerebral Cortex*, 29(6), 2694-2700. doi:10.1093/cercor/bhy138
- [12] Beran, M., Twait, E. L., Smit, A. P., Posthuma, M. F., van Dijk, D., Rabanal, K. M., ... & Vonk, J. M. (2024). The association of sociodemographic factors with total and item-level semantic fluency metrics. *Neuropsychology*, 38(7), 665–678. doi:10.1037/neu0000955
- [13] Vonk, J. M. J., Geerlings, M. I., Avila-Rieger, J. F., Qian, C. L., Schupf, N., Mayeux, R., ... & Manly, J. J. (2023). Semantic item-level metrics relate to future memory decline beyond existing cognitive tests in older adults without dementia. *Psychology and aging*, 38(5), 443-454. doi:10.1037/pag0000747

Acknowledgments

AR received a grant from the Dutch Research Council (NWO VI.Vidi.231C.001).

Socioeconomic Factors in Aphasia Rehabilitation Participation: A Demographic Analysis of a Houston-Based Program

Nikita Gidh^{1*}, Taegen Senawong^{1*}, Eleni Christou-Franklin, and Doris Kung, M.D.³

¹ Department of School of Medicine, Baylor College of Medicine, Houston, TX, US

² Houston Aphasia Recovery Center, Houston, TX, US

³ Department of Neurology, Baylor College of Medicine, Houston, TX, US

*corresponding author, nikita.gidh@bcm.edu and taegen.senawong@bcm.edu

Introduction

Aphasia, a language disorder affecting over two million people in the U.S., is commonly seen after strokes, where recovery relies heavily on rehabilitation (Wu et al. 2020; Evans et al. 2024). However, barriers such as geographical constraints, financial challenges, and a lack of specialized therapists limit access to consistent care (Shrubsole et al. 2023; Scimeca et al. 2022). Therefore, individuals with aphasia often face social isolation and a reduced quality of life (Wu et al. 2020; Shrubsole et al. 2023).

The Houston Aphasia Recovery Center (HARC), a nonprofit organization, directly addresses these challenges by providing a supportive, community-based recovery environment. Over 250 participants from diverse socioeconomic backgrounds engage in group learning activities aimed at improving verbal and receptive communication skills.

Methods

We retrospectively analyzed data from 118 HARC participants who attended at least one session in 2025. Demographics including age, gender, and race/ethnicity were collected. Participant ZIP codes were mapped to county-level per capita income data using the U.S. Census Bureau (2023 dollars). Program-wide fee distribution data were used to calculate an overall average payment level on a 4-point ordinal scale (1=\$5, 2=\$10, 3=\$20, 4=\$30). Overall program-wide proportions were 35%, 23%, 13%, and 29%, respectively giving an expected level of 2.01. A Spearman rank correlation was performed to evaluate the relationship between county per capita income and number of participants. A Chi-square goodness-of-fit test evaluated whether payment level distributions differed between participants from counties above ($n = 25$) versus below ($n = 93$) the program-wide average per capita income (\$41,211).

Results

50% of HARC participants were male, while 50% were female. The mean percentage of the participants was 55.02 years of age. The largest race-ethnicity population was White (53%), followed by Black (31%). Seventy percent (83/118) lived in Harris County, TX and 78% (93/118) were from counties below the US per capita average as seen in **Table 1**. **Figure 1** displays the counties serviced and where some participants are virtual. The Spearman correlation between county per capita income and participant count was weak and not statistically significant ($p = 0.20$, $p = 0.54$). The Chi-square test also found no significant difference in payment level distributions between higher- and lower-income counties ($\chi^2 = 6.28$, $df = 3$, $p = 0.51$).

Conclusions

Overall, there was no relationship between income and program participation implying that HARC services a socioeconomically diverse population. The high proportion of participants from below-average income areas indicates potential success in mitigating financial and geographic barriers to aphasia rehabilitation, such as the provision of virtual access. Future research should collect individual participant data on the daily visit fee for comparison.

References

- Wu C, Qin Y, Lin Z, et al. (2020). Prevalence and Impact of Aphasia among Patients Admitted with Acute Ischemic Stroke. *Journal of Stroke and Cerebrovascular Disease*, 29(5), 104764.
- Evans, E., Jacobs, M., & Ellis, C. (2024). The Intersection of Social Determinants of Health and Post-stroke Aphasia Outcomes: A Need for Intersectional Analysis. *Seminars in Speech and Language*, 45(1), 84–98.
- Shrubsole K, Power E, Hallé MC. (2023). Communication partner training with familiar partners of people with aphasia: A systematic review and synthesis of barriers and facilitators to implementation. *International Journal of Language and Communication Disorders*, 58(2), 601-628.
- Scimeca, M., Abdollahi, F., Peñaloza, C., & Kiran, S. (2022). Clinical perspectives and strategies for confronting disparities in social determinants of health for Hispanic bilinguals with aphasia. *Journal of Communication Disorders*, 98, 106231.

Figure 1. Greater Houston Service Map of HARC Participants in 2025.

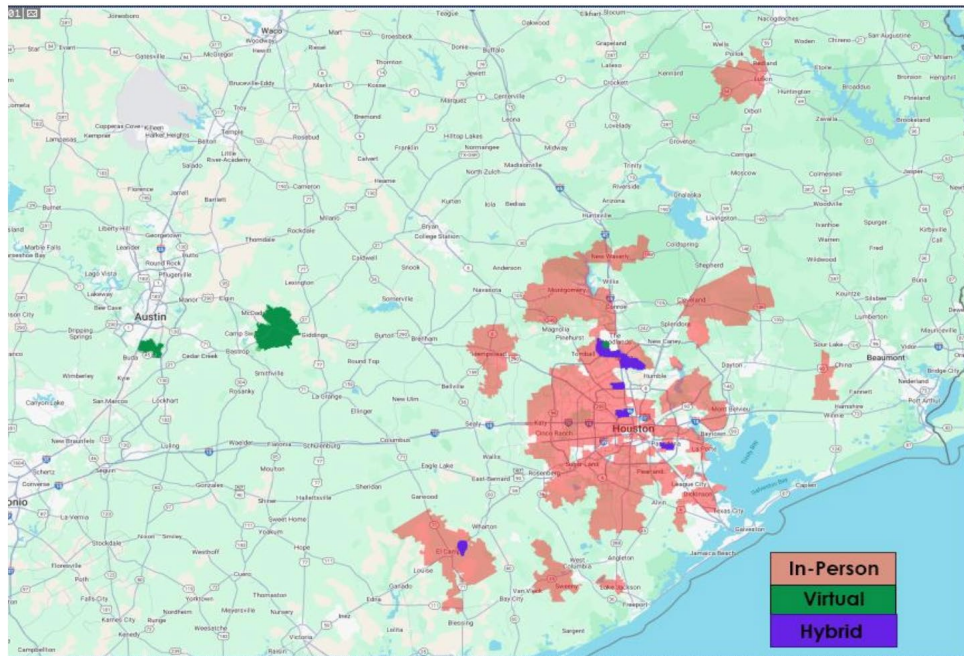


Table 1. HARC Economic Data

County	Number Participants	Per Capita Income	HARC Average Cost Level	Below Program Average
Bastrop	1	\$34,363	2.01	Yes
Brazoria	4	\$41,681	2.01	Yes
Dallas	1	\$41,272	2.01	Yes
Denton	1	\$52,909	2.01	No
Fort Bend	12	\$46,693	2.01	No
Galveston	4	\$44,123	2.01	No
Harris	83	\$39,978	2.01	Yes
Hidalgo	1	\$22,005	2.01	Yes
Liberty	1	\$26,368	2.01	Yes
Montgomery	7	\$48,550	2.01	No
Travis	1	\$59,289	2.01	No
Wharton	2	\$32,579	2.01	Yes
Total: 118		Average (weighted): \$41,211 Average (non-weighted): \$40,817		US Average: \$43,313

Narrative Discourse Rubric for Non-Fluent Aphasia

Isa Godoy*, Tanya Dash, and Esther Kim

Faculty of Rehabilitation Medicine, Department of Communication Sciences and Disorders, Institution, Edmonton, Alberta, Canada

***corresponding author, igodoy@ualberta.ca**

Introduction

Discourse assessment is essential and ecologically valid for rehabilitation of Individuals with non-fluent aphasia (IWA); however, it is typically time-consuming and requires extensive training (Stark et al., 2021). Furthermore, many aphasia assessments are diagnostic and standardized, which is not functional for creating therapy goals (Pritchard et al., 2018; Stark et al., 2021). While discourse analysis has the potential to be a time-conscious and functional approach – since it can be recorded in 5-15 minutes and reflects communication in a real world context – it remains challenging for clinicians due to demands of transcription, coding, and the complexity of analysis (Stark et al., 2021). Although efficient and functional rubrics exist in child language (Heilmann et al., 2010) and education literature (Hill et al., 2020), there is currently no discourse assessment rubric designed to meet the clinical needs of clinicians working with IWA (see Table 1; Heilmann et al., 2010; Hill et al., 2020; Whitworth et al., 2015; Dash & Kar, 2012; Dash & Kar, 2014; Pritchard et al., 2018).

The Rubric for Focused Description (RFD), adapted from education research, meets key criteria for use with non-fluent aphasia but has only been used in one study and lacks psychometric properties with the aphasia population (Dash & Kar, 2014) (see *Table 1*). The Linguistic Underpinnings of Narrative in Aphasia (LUNA) framework was developed to standardize discourse (Dipper et al., 2021). To address the need for a time-efficient, functional tool, the RFD will be revised to align with LUNA. Face validity, content validity, and inter-rater reliability will be assessed to support its clinical utility.

Methods

Participants included seven experienced registered speech-language pathologists with at least two years of experience working with individuals with non-fluent aphasia. Materials included the modified RFD based on LUNA (see *Figure 1*), 17 English discourse samples of non-fluent IWA telling the Cinderella Story from the AphasiaBank database (MacWhinney et al., 2011), and a semi-structured interview guide.

In phase 1, Five clinicians used a think-aloud protocol to score two discourse samples, and participated in a semi-structured interview. Thematic analysis was performed to inform the revisions, establishing face and content validity. Phase 2 is currently underway, in which two clinicians will score 15 discourse samples using the revised rubric, and an inter-rater reliability analysis will be conducted.

Results

The preliminary results of phase 1 have led to five common themes based on which the rubric will be modified: the need for improved clarity, inclusion of examples, and category adjustments; enhancing the rubric's ability to capture non-verbal communication;

prioritizing functional communication over strictly linguistic aspects; recognizing the rubric's potential for tracking progress and setting therapy goals; and ensuring consistent wording across scoring levels.

Phase 2 is currently underway. It is expected that this phase will demonstrate adequate inter-rater reliability, supporting the rubric's consistency and clinical utility.

Conclusion

The revised rubric shows promise as a practical and reliable tool for assessing discourse in individuals with non-fluent aphasia. Further validation through ongoing reliability testing will support its use in clinical settings for tracking progress and guiding therapy.

References

- Dash, T., & Kar, B.R. (2012). Characterizing language proficiency in Hindi and English language: implications for bilingual research. *International Journal of Mind Brain and Cognition*, 2012;3(1):73–105.
- Dash, T., & Kar, B. R. (2014). Bilingual language control and general purpose cognitive control among individuals with bilingual aphasia: evidence based on negative priming and flanker tasks. *Behavioural Neurology*, 2014, 679706.
- Dipper, L., Marshall, J., Boyle, M., Hersh, D., Botting, N., & Cruice, M. (2021). Creating a theoretical framework to underpin discourse assessment and intervention in aphasia. *Brain Sciences*, 11(2), 183.
- Heilmann, J., Miller, J. F., Nockerts, A., & Dunaway, C. (2010). Properties of the narrative scoring scheme using narrative retells in young school-age children. *American Journal of Speech-Language Pathology*, 19(2), 154–166.
- Hill, E., Claessen, M., Whitworth, A., & Boyes, M. (2020). Profiling variability and development of spoken discourse in mainstream adolescents. *Clinical Linguistics & Phonetics*, 35 (2), 117–137.
- Marshall, R. C., & Wright, H. H. (2007). Developing a clinician-friendly aphasia test. *American Journal of Speech-Language Pathology*, 16(4), 295–315.
- Pritchard, M., Hilari, K., Cocks, N., & Dipper, L. (2018). Psychometric properties of discourse measures in aphasia: Acceptability, reliability, and validity. *International Journal of Language & Communication Disorders*, 53(6), 1078-1093.
- Stark, B. C., Dutta, M., Murray, L. L., Fromm, D., Bryant, L., Harmon, T. G., ... & Roberts, A. C. (2021). Spoken discourse assessment and analysis in aphasia: An international survey of current practices. *Journal of Speech, Language, and Hearing Research*, 64 (11), 4366-4389.
- Whitworth, A., Leitão, S., Cartwright, J., Webster, J., Hankey, G. J., Zach, J., Howard, D., & Wolz, V. (2015). Narnia: A new twist to an old tale. A pilot RCT to evaluate a multilevel approach to improving discourse in Aphasia. *Aphasiology*, 29 (11), 1345–1382.

Acknowledgments

Thank you to my supervisor Dr. Tanya Dash for her continued support, and to Ryan Kaefer, Gabby Lai and Stephanie Huck for their assistance in several aspects of this project.

Figure 1. The Rubric for Focused Description edited to follow the Linguistic Underpinnings of Narrative in Aphasia Framework.

Reminder to share your thought process out loud

Strong 3 Points	Average 2 Points	Weak 1 Point
Macrostructure: Story grammar, organization of discourse.		
3 Presents a vivid, memorable picture of a person, place or things.	2 Presents a clear picture of a person, place, or thing.	1 Presents an unclear or confusing picture of a person, place and thing.
3 Establishes a dominant, or main, impression of the picture.	2 Focuses on important characteristic(s) of the picture.	1 Presents an unfocused array of characteristics of the picture.
3 Conveys a clear sense of purpose.	2 Suggests the speaker's purpose.	1 Unclear or inadequate indication of speakers' purpose.
3 Uses a clear, consistent method of organization of events.	2 Method of organization is usually clear and consistent.	1 Method of organization is difficult to identify or follow.
Coherence: <i>Do all the sentences as a whole create a logical message? Is the message conveyed? Tip: think about the sequence of events.</i>		
3 <i>Coherence</i> demonstrated through some appropriate use of devices (transitions, pronouns, causal linkage, etc).	2 <i>Coherence</i> is evident; may depend on holistic structure, most transitions between <i>ideas</i> are appropriate.	1 Evidence of <i>coherence</i> may depend on sequence. If present, transitions may be simplistic or even redundant.
Propositional: Microstructure, sentence level of discourse		
Cohesion: <i>Does each sentence logically relate to the sentences that it immediately proceeds and precedes? Tip: Each sentence needs to add information to the main message to receive a 3.</i>		
3 <i>Cohesion</i> demonstrated through some appropriate use of devices (transitions, pronouns, causal linkage, etc).	2 <i>Cohesion</i> is evident; may depend on holistic structure, most transitions between <i>sentences</i> are appropriate.	1 <i>Cohesion</i> is minimal or not evident. There are few to no logical connections between each sentence.
Linguistic: Syntactic construction, lexical retrieval, and phonological processing.		
3 Very few, if any errors in grammar, pronunciation and presence of few pauses (filled and unfilled).	2 Small number of errors in grammar, pronunciation and presence of indefinable pauses (filled and unfilled).	1 Numerous errors in grammar, pronunciation and presence of pause (filled and unfilled).
Pragmatic: How communication is adjusted based on environmental, personal, and interactional factors		
3 All or most information shared is relevant to the present context.	2 Some information shared is relevant to the present context.	1 Little to none of the information shared is relevant to the present context.

Table 1: Existing Narrative Discourse Assessments

	Narrative Scoring Scheme (NSS)	Curtin University Discourse Protocol (CUDP)	Western Aphasia Battery - Revised (WAB- R)	Rubric for Focused Description
Sufficient Psychometric Properties	✓	✓	✓	
Time-Conscious	✓			✓
Checklist/ Rubric Coding Scheme	✓			✓
For Aphasia Population		✓	✓	✓
For Treatment Purposes	✓	✓		✓

Grammatical Analysis of Narrative in Broca's Aphasia, Wernicke's Aphasia, and Age-Matched Non-Aphasic Speakers

Jean K. Gordon^{1*}

¹ Department of Communicative Disorders, University of Rhode Island,
(Rhode Island), USA

***corresponding author, jean.gordon@uri.edu**

Introduction

Difficulty producing grammatically complete and well-formed utterances is a hallmark of Broca's aphasia (BA), specifically agrammatic BA. However, degrees of agrammatism are difficult to quantify, particularly in milder forms primarily characterized by simplified sentence structures, due to a lack of comparable data from age-matched individuals without aphasia. In addition, interpretation of the underlying deficits giving rise to agrammatism must rely on comparison to individuals with non-agrammatic aphasia (Faroqi-Shah, 2023). One relevant comparison is to individuals with Wernicke's aphasia (WA), many of whom show paragrammatism, a poorly understood production pattern involving grammatical deviations that show similarities and differences from agrammatism (Matchin et al., 2020). This study leverages the AphasiaBank database (MacWhinney et al., 2011) to both generate normative data against which grammatical performance can be judged, and to extend prior work (Gordon et al., 2022) examining differences between agrammatism and paragrammatism.

Methods

Twenty individuals each with BA, WA, and without aphasia (NoA) were selected from AphasiaBank. All groups were age-matched and the two aphasia groups were matched on severity of aphasia (WAB-R, Kertesz, 2006) (Table 1). Utterances were extracted from the Cinderella story retell and analyzed using the C-QPA (Berndt et al., 2000, Fromm et al., 2021, Saffran et al., 1989). In addition, utterances were manually coded for 7 major grammatical components: subjects, main verbs, auxiliary verbs, noun modifiers, verb modifiers, subordinate clauses, and quotes. Types of subject noun phrases and main verbs were also coded, to examine speakers' strategies for filling these obligatory slots.

Results

The BA group differed from the WA group on all C-QPA parameters (Table 1) except SNP length and % well-formed sentences. Both aphasia groups differed from the NoA group on all parameters except % words produced in sentences by WA individuals. Subject and main verb omission were both more likely in BA than WA, and in WA than in NoA (also Figure 1). However, the likelihood of omitting verbs was significantly greater than omitting subjects in BA ($p<.001$) compared to WA ($p=.02$) and NoA ($p=.73$). Of the main verbs produced, copulas were more frequent by BA and WA than NoA, but only WA produced more light verbs than NoA. Of the subjects produced, pronouns were more frequently used by WA than both BA and NoA. Figure 1 illustrates that greater verb phrase elaboration arises from more frequent auxiliary verbs and objects for both WA and NoA than BA, but

also more verb modifiers by NoA. Subordinate clauses were produced surprisingly often by NoA speakers, but almost never by BA speakers.

Conclusions

Results provide preliminary normative data to help interpret patterns of both agrammatism and paragrammatism. Similarities were observed between BA and WA groups, including the reliance on light constructions (e.g., pronouns, copulas), but findings reinforce that production and elaboration of the verb is the primary difficulty in agrammatism. A tendency to perseverate on both lexical and grammatical constructions contributed to idiosyncratic sources of variability.

References

- Berndt, R.S., Wayland, S., Rochon, E., Saffran, E., & Schwartz, M. (2000). *Quantitative Production Analysis: A training manual for the analysis of aphasic sentence production*. Psychology Press.
- Faroqi-Shah, Y. (2023). A reconceptualization of sentence production in post-stroke agrammatic aphasia: the Synergistic Processing Bottleneck model. *Frontiers in Language Sciences*.
- Fromm, D., Katta, S., Paccione, M., Hecht, S., Greenhouse, J., MacWhinney, B., Schnur, T.T. (2021). A comparison of manual vs automated Quantitative Production Analysis of connected speech. *Journal of Speech-Language-Hearing Research*, 64, 1271-1282.
- Gordon, J.K., Peters, E.L., Westbrook, K.D., Wickre, A.A., & Mansour, A.D. (2022). Grammatical structures and errors in paragrammatism. Presented at the *Academy of Aphasia*, Philadelphia, PA.
- Kertesz, A. (2006). *Western Aphasia Battery-Revised* [Aphasia assessment battery]. Pearson.
- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for studying discourse. *Aphasiology*, 25, 1286-1307.
- Matchin, W., Basilakos, A., Stark, B.C., den Ouden, D.-B., Fridriksson, J., & Hickok, G. (2020). Agrammatism and paragrammatism: A cortical double dissociation revealed by lesion-symptom mapping. *Neurobiology of Language*, 1(2), 208–225.
- Saffran, E.M., Berndt, R.S., & Schwartz, M.F. (1989). The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language*, 37(3), 440–479.

Figure 1. Proportion of utterances containing at least one occurrence of each major grammatical component for each participant group

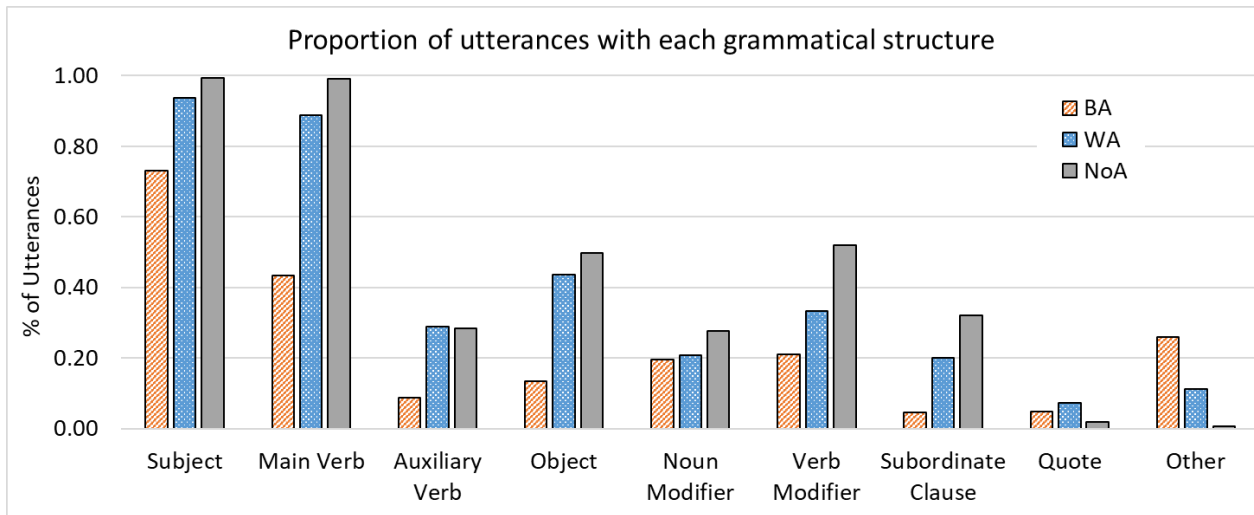


Table 1. Mean demographic and grammatical data for each participant group

	Group Means			T-Test p-values		
	Broca (BA)	Wernicke (WA)	No Aphasia (NoA)	BA vs WA	BA vs NoA	WA vs NoA
Age (years)	66.6	69.9	69.4	0.367	0.431	0.901
WAB Score (out of 100)	52.1	53.3	NA	0.558	NA	NA
Male:Female Ratio	13:7	12:8	14:6	NA	NA	NA
CQPA Data						
Speech Rate (WpM)	32.4	95.2	131.2	0.000	0.000	0.002
Utterance Length (words)	2.509	5.521	8.747	0.000	0.000	0.000
Mean Subject Noun Phrase (SNP) Length	1.019	1.055	1.144	0.244	0.000	0.000
Mean Verb Phrase (VP) Length	1.619	2.591	3.615	0.000	0.000	0.000
Embedding Index	0.029	0.198	0.319	0.000	0.000	0.003
% Words in Sentences	0.462	0.839	0.906	0.000	0.000	0.068
% Well-Formed Sentences	0.803	0.862	0.998	0.074	0.000	0.000
Manually Coded Data						
No. Utterances Examined	296	372	627	NA	NA	NA
% Missing Subjects	0.251	0.059	0.006	0.000	0.000	0.000
% Pronoun Subjects	0.413	0.706	0.514	0.002	0.206	0.000
% Missing Main Verbs	0.557	0.107	0.007	0.000	0.000	0.000
% Copula Main Verbs	0.334	0.248	0.153	0.324	0.033	0.027
% Heavy/(Heavy+Light)	0.576	0.509	0.668	0.564	0.401	0.005

Note: Yellow highlighting indicates significance at $p < .05$; orange indicates $p < .001$.

NfL, GFAP and TDP-43 as Predictive Biomarkers of Post-Stroke Cognitive Impairment

Nerea Gorostiola-Oyarzabal^{1,2*}, Ana Joya¹, Maria del Mar Freijo^{4,5}, Raffaella Cipriani², Estibaliz Capetillo-Zarate², Abraham Martín^{2,3}, Simona Mancini^{1,3}

¹Basque Center on Cognition, Brain and Language, San Sebastian (Gipuzkoa), Spain.

²Achucarro Basque Center for Neuroscience, Leioa (Bizkaia), Spain.

³Ikerbasque Basque Foundation for Science, Bilbao (Bizkaia), Spain.

⁴Neurovascular Group, Biocruces Health Research Institute, Barakaldo (Bizkaia), Spain.

⁵Department of Neurology, Cruces University Hospital, Barakaldo (Bizkaia), Spain.

***corresponding author: n.gorostiola@bcbl.eu**

Introduction

Stroke, particularly the ischemic subtype, is a major medical condition recognized as one of the leading causes of mortality and long-term disability worldwide (Quian et al., 2012). Post-stroke cognitive impairment (PSCI) is among the most prevalent consequences, affecting approximately one-third of survivors. It is characterized by deficits across multiple cognitive domains, including language, attention, memory or reasoning (Yue et al., 2016). The neuropathological mechanisms underlying this condition are primarily driven by neuronal ischemia, which triggers a cascade of disruptions in energy metabolism, oxidative stress, and inflammatory responses, ultimately reflected in altered biomarker concentrations (Lee and Park, 2018). Examples include neurofilament light chain protein (NfL), glial fibrillary acidic protein (GFAP), and TDP-43, which are neuronal and axonal proteins detectable in patients' blood and which have been associated with greater clinical severity (Akhoundzadeh and Shafia, 2021; Lewis et al., 2008; Thamisetty et al., 2018). Although research suggests these biomarkers hold promise for early PSCI diagnosis and prognosis, no clear consensus has been reached.

The aim of this study is to investigate whether stroke patients exhibit elevated NfL, GFAP, and TDP-43 levels compared to healthy controls, and whether these levels correlate with language and cognitive performance. A longitudinal design was used, assessing biomarkers concentration and cognitive performance at two time points, acute and subacute post-stroke phases (see Figure 1).

Methods

We present preliminary findings from a sample of acute-stroke patients (N=28, all native Spanish speakers) with mild aphasia, admitted to the Neurology Department at Cruces University Hospital (Bilbao, Spain). Language deficits were assessed using a Spanish-language battery covering multiple linguistic domains (including repetition, discrimination, sentence elicitation and verification, grammaticality judgment, and picture naming), along with domain-general cognitive tasks (such as the Attention Network Task, Raven's Coloured Progressive Matrices, and visual and digit span tasks). Biomarker concentrations were measured using SIMOA technology and compared to those of 30 healthy donors. This study extends a previous investigation by incorporating the analysis of TDP-43 and including data from a second time point, one month after stroke onset.

Results

Preliminary results showed elevated NfL and GFAP levels in stroke patients compared to controls, and non-significant differences for TDP-43. Biomarker concentrations were higher during the acute phase and declined over time, while patients' linguistic and cognitive performance improved at the second time point. Regarding the relationship between biomarkers and cognitive performance, higher GFAP concentrations were observed in patients with poorer outcomes in language, attention, memory, and reasoning. In contrast, NfL and TDP-43 exhibited the opposite trend.

Conclusions

Our findings align with existing literature, confirming the expected elevation of neurodegeneration biomarkers in post-stroke patients. Notably, GFAP levels were particularly elevated among individuals with language and cognitive impairment. However, these results should be interpreted with caution due to potential confounding factors, including the limited sample size and variability in blood sampling timing. Data collection is ongoing. Future work will focus on investigating the role that lesion size and location play in biomarker concentration and PSCI.

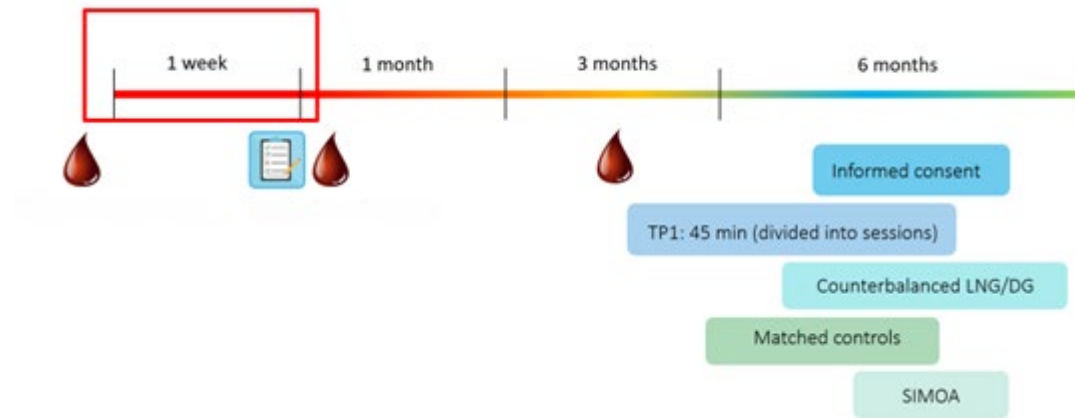
References

- Akhoundzadeh, K., & Shafia, S. (2021). Association between GFAP-positive astrocytes with clinically important parameters including neurological deficits and/or infarct volume in stroke-induced animals. *Brain Research*, 1769, 147566.
- Lee, J. H., & Park, J. H. (2018). Development of an item list to assess bilateral upper extremity function of stroke patients with hemiplegia. *NeuroRehabilitation*, [42\(1\), 37-42](#).
- Lewis, S.B., Wolper, R.A., Miralia, L., Yang, C., & Shaw, G. (2008). Detection of phosphorylated NF-H in the cerebrospinal fluid and blood of aneurysmal subarachnoid hemorrhage patients. *Journal of Cerebral Blood Flow and Metabolism*, 28(6), 1261–1271.
- Qian, L., Ding, L., Cheng, L., Zhu, X., Zhao, H., Jin, J., Guan, D., Zhang, B., Chen, X., & Xu, Y. (2012). Early biomarkers for post-stroke cognitive impairment. *Journal of Neurology*, 259, 2111-2118.
- Thammisetty, S. S., Pedragosa, J., Weng, Y. C., Calon, F., Planas, A., & Kriz, J. (2018). Age-related deregulation of TDP-43 after stroke enhances NF-κB-mediated inflammation and neuronal damage. *Journal of Neuroinflammation*, 15, 1-15.
- Yue, W., Wang, A., Zhu, R., Yan, Z., Zheng, S., Wang, J., Huo, J., Li, X., & Ji, Y. (2016). Association between carotid artery stenosis and cognitive impairment in stroke patients: a cross-sectional study. *PloS one*, 11(1), e0146890.

Acknowledgments

[The authors acknowledge funding from RICORS-Ictus (RD21/0006/0016) (Health Institute Carlos III) and IKUR Program (Basque Government).]

Figure 1. Study longitudinal design.



Translanguaging in aphasia: An innovative framework for multilingual language recovery

Teresa Gray^{1*}, Sarah Ballerda¹, Arissa Ventura¹, and Chaleece Sandberg²

¹ Department of Speech, Language, and Hearing Sciences, San Francisco State University, San Francisco, CA, USA

² Department of Communication Sciences and Disorders, Penn State College of Health and Human Development, State College, PA, USA

***corresponding author, teresag@sfsu.edu**

Introduction

Past research has shown that aphasia treatment targeting abstract words results not only in improvements in the trained words, but also in generalized improvement to untrained concrete words. This treatment is called abstract semantic associative network training (AbSANT; Sandberg & Kiran, 2014; Sandberg & Gray, 2020). We have explored the efficacy of AbSANT in bilingual populations, resulting in bilingual AbSANT (BAbSANT; Gray et al., 2024; Sandberg et al., 2021). BAbSANT methodology follows established bilingual aphasia treatment methodologies which isolate languages, i.e., treatment is delivered in monolingual contexts. However, if bilingual PWA are translanguaging (i.e., using two languages to communicate) in their natural environments, then treatment should do the same, yet few to no studies examine these effects. We hypothesized that training abstract words in a translanguaging context would result in both direct training and generalization effects. As an exploratory analysis, we compared translanguaging effect sizes to those from BAbSANT and AbSANT which train one language at a time.

Methods

Two Tagalog-English bilingual PWA and two Spanish-English bilingual PWA participated in this study. Three participants completed BAbSANT that includes one phase in English abstract training in one category and one phase in Tagalog or Spanish abstract training in another category. One Spanish-English PWA completed AbSANT in Spanish. All participants completed a translanguaging phase that permitted the free usage of both languages during treatment. Phases across participants were counterbalanced.

Categories used for Spanish AbSANT and Tagalog-English and Spanish-English BAbSANT phases were previously normed. For the translanguaging phase, data was normed to identify a category and generate target words for treatment. Thus, 15 adult Tagalog-English speakers and 15 adult Spanish-English speakers without aphasia were recruited to develop culturally and linguistically appropriate stimuli (10 abstract and 10 concrete words). The translanguaging treatment protocol is the same as AbSANT and BAbSANT. First, the participant completes the brainstorm to develop salient semantic features for the target words. After this initial session, each treatment session includes category sorting, feature selection, yes/no questions, and free generative naming. Generative naming probes in both languages are given to measure the dependent variable at baseline, weekly throughout treatment, and post-treatment.

Results

Preliminary results show that training abstract words in a Tagalog-English translanguaging context and Spanish-English translanguaging context resulted in small and large direct training effects for two Tagalog-English PWA and a small direct training effect for one Spanish-English PWA. A small generalization effect was observed for one Tagalog-English PWA and two Spanish-English PWAs. For one Tagalog-English PWA, the effect sizes in the translanguaging context were the same as those in Tagalog only (the dominant language). For the other participants, the effect sizes in the translanguaging context were more consistently significant for both direct training and generalization than in any single language. (See Table 1 for effect sizes.)

Conclusions

Findings show that training abstract words in a translanguaging context results in a) direct training and generalization effects and b) outcomes that are just as effective as training words in a single-language context for Tagalog-English PWA and more effective for Spanish-English PWA.

References

- Gray, T., Palevich, J., & Sandberg, C. (2024). Bilingual Abstract Semantic Associative Network Training (BAbSANT): A Russian–English case study. *Bilingualism: Language and Cognition*, 27(2), 229-245.
- Sandberg, C., & Kiran, S. (2014). How justice can affect jury: Training abstract words promotes generalisation to concrete words in patients with aphasia. *Neuropsychological Rehabilitation*, 24(5), 738-769.
- Sandberg, C. W., & Gray, T. (2020). Abstract semantic associative network training: A replication and update of an abstract word retrieval therapy program. *American Journal of Speech-Language Pathology*, 29(3), 1574-1595.
- Sandberg, C. W., Zacharewicz, M., & Gray, T. (2021). Bilingual abstract semantic associative network training (BAbSANT): A Polish-English case study. *Journal of Communication Disorders*, 93, 106143.

Table 1. Effect sizes for PWA01, PWA02, PWA03, and PWA04.

PWA01	Direct Training	English Abstract wedding	0.44
		Tagalog Abstract school	12.44
		TL Abstract park	11.63
	Within language generalization	English Concrete wedding	3.16
		Tagalog Concrete school	0.68
		TL Concrete park	0.33
	Cross language generalization	Tagalog Abstract wedding	1.78
		Tagalog Concrete wedding	1.48
		English Abstract school	4.89
PWA02	Direct Training	English Abstract school	2.02
		English Abstract wedding	12.30
		Tagalog Abstract school	3.35
	Within language generalization	TL Abstract park	7.60
		English Concrete wedding	0.09
		Tagalog Concrete school	2.89
	Cross language generalization	TL Concrete park	2.92
		Tagalog Abstract wedding	3.00
		Tagalog Concrete wedding	2.00
PWA03	Direct Training	English Abstract school	0.63
		English Abstract school	0.40
		Spanish Abstract restaurant	0.32
	Within language generalization	English Concrete university	0.44
		TL Abstract wedding	5.84
		Spanish Concrete restaurant	0.15
	Cross language generalization	English Abstract university	-0.26
		TL Concrete wedding	2.39
		English Abstract restaurant	0.00
PWA04	Direct Training	Spanish Abstract university	0.00
		English Concrete restaurant	-0.43
		Spanish concrete university	-0.54
	Within language generalization	Spanish Abstract restaurant	0.00
		Spanish Concrete university	4.44
		TL Abstract wedding	6.90
	Cross language generalization	Spanish Concrete restaurant	4.38
		Spanish Abstract university	5.31
		TL Concrete wedding	4.69

Note: Direct effect size (ES) calculations and interpretations were based on Beeson & Robey (2006, 2008). For direct training effects, a small ES is 6.5, a medium ES is 8.0, and a large ES is larger than 9.5. For within-language and cross-language generalization effects, small ES is ≥ 2 , a medium ES is ≥ 5 , and a large ES is ≥ 8 . TL = translanguaging.

Identifying Neuropathological Disease in Primary Progressive Aphasia through Analysis of Spontaneous Speech: A Matter of Artificial Intelligence

Daniel Gutstein¹, Michael Iorga², Jane Stocks^{1,3}, Nathan Gill^{1,4}, Jennifer Sleeman⁵, Tamar D. Gefen^{1,3}, Michelle Los MS¹, Eliyahu Lazovsky MPH, Caroline Nelson¹, Changiz Geula^{1,6}, Sandra Weintraub^{1,3,7}, M-Marsel Mesulam^{1,7}, Todd Parrish^{1,2,8}, and Elena Barbieri^{1,9}

¹ Mesulam Center for Cognitive Neurology and Alzheimer's Disease, Northwestern University, Chicago, IL, USA

² Department of Radiology, Northwestern University, Chicago, IL, USA

³ Department of Psychiatry and Behavioral Sciences, Northwestern University, Chicago, IL, USA

⁴ Department of Preventive Medicine, Northwestern University, Chicago, IL, USA

⁵ School of Professional Studies, Northwestern University, Chicago, IL, USA

⁶ Department of Cell and Developmental Biology, Northwestern University, Chicago, IL, USA

⁷ Ken and Ruth Davee Department of Neurology, Northwestern University, Chicago, IL, USA

⁸ Department of Biomedical Engineering, Northwestern University, Chicago, IL, USA

⁹ Department of Physical Medicine and Rehabilitation, Northwestern University, Chicago, IL, USA

***corresponding author, daniel.gutstein@northwestern.edu**

Introduction

The analysis of spontaneous speech samples provides the ideal context for the investigation of language abnormalities in Primary Progressive Aphasia (PPA) (Mack et al., 2021), which is defined by a gradual deterioration of language abilities due to various neuropathologies that can be diagnosed at post-mortem brain autopsy (Mesulam et al., 2022). We present a novel application of artificial intelligence to the spontaneous speech of individuals with PPA that aims to 1) differentiate healthy individuals from those with clinically diagnosed PPA and 2) predict the neuropathologic disease underlying PPA.

Methods

Natural Language Processing (NLP) methods were used to extract two distinct feature sets – transformer embeddings and classical quantitative linguistic measures – from transcribed narratives obtained from the re-telling of Cinderella's story (Thompson et al., 2012). For each feature set, neural network-based machine learning ensemble models classified every participant as either living individuals who are cognitively healthy (NC), or deceased individuals with PPA due to Alzheimer's Disease (dAD) or 4-repeat tauopathies under the umbrella of frontotemporal lobar degeneration (FTLD-4Rtau). Data in the classical model (features from SpaCy and Stanza) were grouped into thematic subclusters representing noun-dependencies, open parts of speech, etc. Classical model features were assessed using a feature-wise permutation approach.

Results

Both the transformer space and the classical linguistics feature space successfully distinguished the transcribed spontaneous speech samples of NC from those of patients with PPA. Both sets of linguistic features also successfully differentiated between the transcripts of dAD and FTLD-4Rtau neuropathologies within the deceased PPA cohort.

Permutation of individual features in the classical features model revealed that measures pertaining to fluency contributed to the prediction of clinical class membership: cognitively healthy individuals or those with PPA. The permutation of lexical diversity and coherence features caused the predictive capacity of the model to drop with respect to FTLD-4Rtau and dAD but not for cognitively healthy individuals, whereas the permutation of variables pertaining to dependencies between verbs and their arguments as well as average dependency distance caused the predictive capacity of the model to drop with respect to FTLD-4Rtau but not dAD.

Conclusions

Our analysis presents the foundations of an AI framework applied to spontaneous speech that aims to improve disease detection and differential diagnosis without the aid of traditional imaging or pathological biomarkers, which may not always be available to clinical practitioners. The findings suggest that AI-driven approaches could enhance the diagnosis of PPA and other aphasias and present new pathways for targeted, non-pharmacologic interventions aimed at alleviating disease specific communication impairments. Future research will incorporate speech rate measures within a broader array of spontaneous speech to analyze additional neurological conditions and provide objective, quantitative measures of speech impairment and disease heterogeneity.

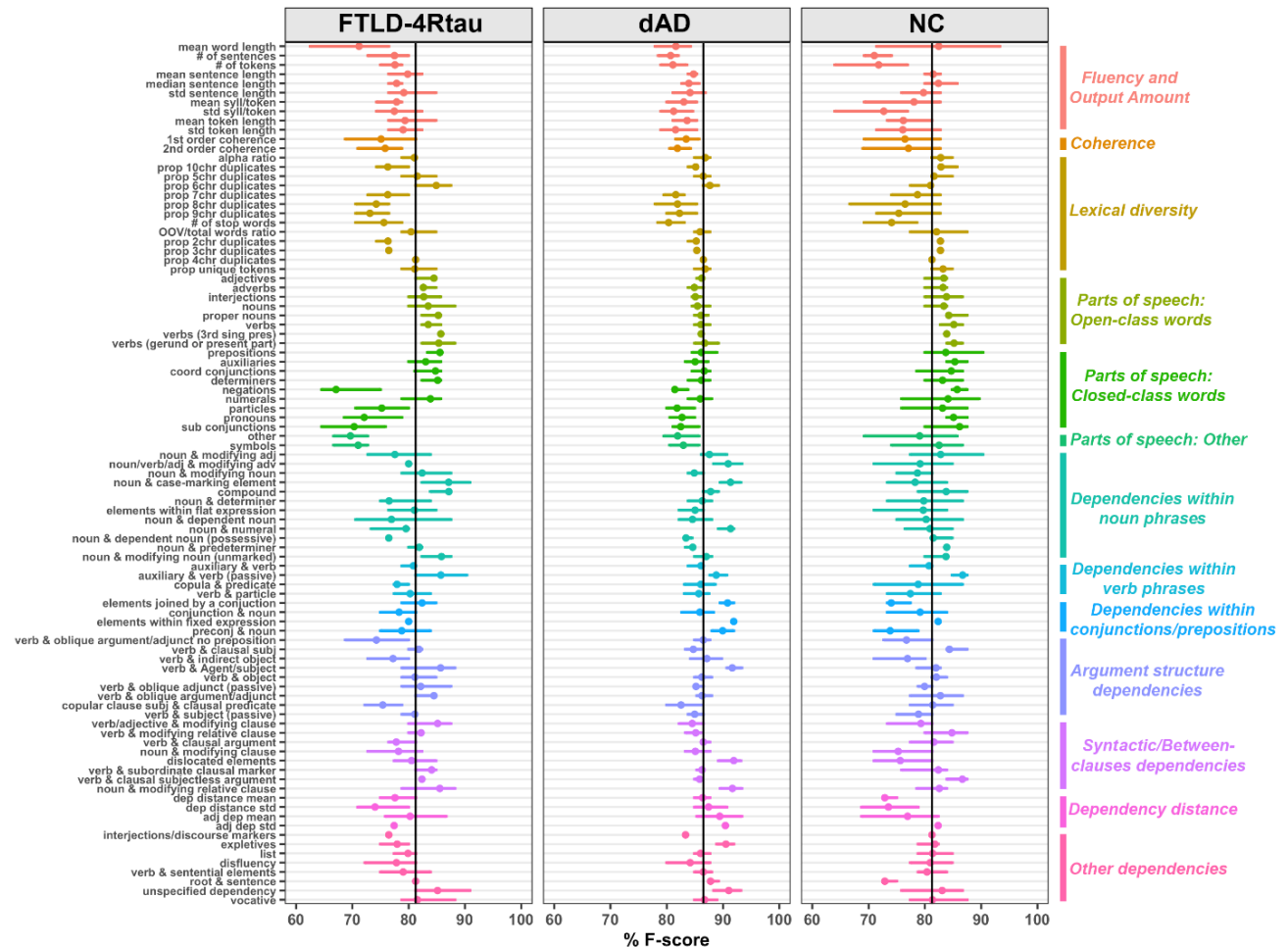
References

- Mack, J. E., Barbieri, E., Weintraub, S., Mesulam, M. M., & Thompson, C. K. (2021). Quantifying grammatical impairments in primary progressive aphasia: Structured language tests and narrative language production. *Neuropsychologia*, 151, 107713.
- Mesulam, M. M., Coventry, C. A., Bigio, E. H., Sridhar, J., Gill, N., Fought, A. J., Zhang, H., Thompson, C. K., Geula, C., Gefen, T., Flanagan, M., Mao, Q., Weintraub, S., & Rogalski, E. J. (2022). Neuropathological fingerprints of survival, atrophy and language in primary progressive aphasia. *Brain*, 145(6), 2133–2148.
- Thompson, C. K., Cho, S., Hsu, C. J., Wieneke, C., Rademaker, A., Weitner, B. B., ... & Weintraub, S. (2012). Dissociations between fluency and agrammatism in primary progressive aphasia. *Aphasiology*, 26(1), 20-43.

Acknowledgments

The study was funded by the National Institute of Health through grants 5R01AG077444, P30AG072977, P30AG013854, and R01AG062566, as well as by the Karen Toffler Charitable Trust. The authors wish to thank Dr. Cynthia K. Thompson and Dr. Jennifer Mack for providing the transcribed speech samples. The authors also acknowledge Jaiashre Sridhar and Christina Coventry for their yearslong contributions managing the PPA project, as well as Jillian Brunner and Carolina Hernandez for their work on further refining the transcriptions. This submission is not included as part of a specific symposium.

Figure 1. Mean Percentage F-scores (round points) and 95% confidence intervals (bars) in predicting each group, for pretrained classical model when each variable was permuted/sampled without replacement. Colors mark subgroups of variables. Black vertical lines mark the overall F score of the full classical model before the introduction of any post-hoc individual variable permutation.



Semantic relatedness and underlying sources of progressive anomia due to Alzheimer's Disease versus FTLD-TDP-C

Loreece G Haddad^{1*}, Lauren Ables-Torres¹, Michelle Los¹, Sandra Weintraub^{1,3}, Tamar Gefen^{1,3}, Marek-Marsel Mesulam^{1,4} & Elena Barbieri^{1,2}

¹Mesulam Center for Cognitive Neurology and Alzheimer's Disease, Northwestern University, Chicago, IL, USA

²Department of Physical Medicine and Rehabilitation, Northwestern University, Chicago, IL, USA

³Department of Psychiatry and Behavioral Sciences, Northwestern University, Chicago, IL, USA

⁴Department of Neurology, Northwestern University, Chicago, IL, USA

***corresponding author, loreece.haddad@northwestern.edu**

Introduction

Primary progressive aphasia (PPA) is a progressive language disorder that can be caused by various neurodegenerative diseases including Alzheimer's disease (PPA-AD) and TDP-43 proteinopathy Type C (PPA-TDP-C, see Mesulam et al., 2022). Word-finding difficulties (i.e., anomia) are common in PPA but may take different forms. In the semantic variant (PPA-S, caused in 90% of cases by TDP-C), severe naming deficits co-occur with severe word comprehension impairment and progressive dissolution of the conceptual boundaries between members of the same category (i.e., semantic blurring). In PPA-S, anomia is due to verbal conceptual knowledge loss (e.g., knowing the difference between *lion* and *zebra*) (Hurley et al., 2012; Mesulam et al., 2013). In other forms of PPA, anomia co-occurs with phonological errors or circumlocutions (Leyton et al., 2014), and is likely due to difficulty accessing the word phonological representation, which may be overcome by providing a phonemic cue (i.e., the first sound of the word). This study investigates the relationship between semantic blurring and anomia in early stages of PPA-AD and PPA-TDP-C.

Methods

Thirty-two individuals with autopsy-confirmed AD (n=22) or TDP-C (n=10) neuropathological diagnosis who scored within mild to normal range on the Western Aphasia Battery – Revised Aphasia Quotient (WAB-AQ: 71.7-97) were included in the study. Participants underwent a standard language battery that included tests for picture naming (Boston Naming Test, BNT) and word comprehension (Peabody Picture Vocabulary Test, PPVT). Participants also performed a computerized word-to-picture matching task (Picture Pairs Test, PicPairs) where they heard single words depicting objects and were instructed to point to the corresponding object from a selection of two. Object choices either belonged to the same semantic category (related items, e.g., *celery* and *radishes*) or different semantic categories (unrelated items, e.g., *celery* and *violin*). Using the average and standard deviation from a group (n = 34) of healthy participants, Z-scores were computed for accuracy (acc) and reaction time (RT) on the PicPairs,

separately for related and unrelated trials. Z-scored RTs were correlated with percentage of successful phonemic cues on the BNT.

Results

While the two groups did not differ in aphasia severity (WAB-AQ) or performance on the Mini-Mental State Examination, the PPA-TDP-C group exhibited lower accuracy and longer RTs than the PPA-AD group for related (but not unrelated) items on the PicPairs. Across groups, the longer RTs to related (but unrelated) trials were associated with poor efficacy of phonemic cues in the face of naming difficulty. PPA-TDP-C group benefited less from phonemic cues than the PPA-AD group, that is they were still unable to name an object even when provided the first sound of a word describing it.

Conclusions

Individuals with PPA-TDP-C had greater difficulty understanding verbal concepts denoting members of the same semantic category, while those with PPA-AD showed similar responses to verbal concepts regardless of their semantic association. Lack of efficacy of phonemic cues for failed items on the BNT and its association with performance on the PicPairs reinforce the finding that anomia in TDP-C stems from impaired verbal conceptual knowledge and not from difficulty retrieving the word phonological representation.

References

- Hurley, R. S., Paller, K. A., Rogalski, E. J., & Marsel Mesulam, M. (2012). Neural mechanisms of object naming and word comprehension in primary progressive aphasia. *Journal of Neuroscience*, 32(14), 4848–4855.
- Leyton, C. E., Ballard, K. J., Piguet, O., & Hodges, J. R. (2014). Phonologic errors as a clinical marker of the logopenic variant of PPA. *Neurology*, 82(18), 1620-1627.
- Mesulam, M. M., Wieneke, C., Hurley, R., Rademaker, A., Thompson, C. K., Weintraub, S., & Rogalski, E. J. (2013). Words and objects at the tip of the left temporal lobe in primary progressive aphasia. *Brain*, 136(2), 601-618.
- Mesulam, M. M., Coventry, C. A., Bigio, E. H., Sridhar, J., Gill, N., Fought, A. J., ... & Rogalski, E. J. (2022). Neuropathological fingerprints of survival, atrophy and language in primary progressive aphasia. *Brain*, 145(6), 2133-2148.

Acknowledgments

This research was funded by NIH through grants NIA 5R01AG077444 (M-M.M.), NIA P30AG072977 and NIA P30AG013854 (Mesulam Center grants), and by the Karen Toffler Charitable Trust (E.B., T.G.).

Social Network Composition Influences Chronic Post-Stroke Aphasia Recovery

Lauren Hammond^{1*}, Lisa Norris², William Matchin¹, Abigail Hogan¹, Julius Fridriksson¹, and Dirk den Ouden¹

¹ Department of Communication Sciences and Disorders, University of South Carolina, Columbia, South Carolina, United States of America

² Speech Language Pathology Program, Columbia College, Columbia, South Carolina, United States of America

***corresponding author, lmh17@email.sc.edu**

Introduction

Social networks are foundational determinants of health, particularly in aging adults and individuals with chronic neurological conditions (Berkman et al., 2000; Kelly et al., 2017; Liu et al., 2023). For persons with aphasia (PWA), social participation is often compromised due to language impairments, resulting in social withdrawal, smaller network size, and fewer opportunities for communication (Boden-Albala et al., 2005; Brissette et al., 2000). While previous research has emphasized the importance of social engagement in stroke rehabilitation, structural aspects of social networks (SN), such as degree, density, and closeness, remain underexplored in aphasiology (Northcott et al., 2016; Vickers, 2010). Understanding these structural features is essential to developing holistic, person-centered approaches to rehabilitation. This study addressed three primary objectives: (1) to describe the social network structure of PWA; (2) to examine demographic and clinical predictors of network characteristics; and (3) to evaluate whether social network variables predict longitudinal changes in aphasia severity.

Methods

Forty-three PWA (≥ 12 months post-stroke) from the POLAR study were included. Social network data were collected via semi-structured interviews with PWA and a primary caregiver. Four SN metrics were calculated: degree, closeness, density, and alter closeness. Psychosocial and clinical data included language scores (WAB-R; Kertesz, 2007), perceived social support, and quality of life (SAQOL-39; Hilari et al., 2009). For the longitudinal subset ($n = 29$), WAB-R AQ scores were available at two time points: immediately post-treatment and six months later. Associations between SN metrics and behavioral outcomes were examined using Spearman correlations and linear regression.

Results

Figure 1 describes the SN composition of PWA. Compared to normative data (Cornwell et al., 2009), PWA had significantly smaller networks ($M = 2.8$ alters). Regression analysis (Table 1) revealed that social closeness was significantly predicted by fluency classification ($p = .013$), age at stroke onset ($p = .016$), and perceived social support ($p = .029$). Critically, a hierarchical linear regression predicting change in WAB-R AQ scores found that lower network density significantly predicted greater improvement in aphasia severity ($p = .019$).

Conclusions

This study offers compelling evidence that SN structure, particularly network density and closeness, influences recovery trajectories in aphasia. These findings not only strengthen the case for socially grounded models of aphasia rehabilitation but also offer practical strategies for Speech Language Pathologists (SLPs) to enhance treatment outcomes by considering their clients' broader social ecology. Integrating social network analysis into both research and rehabilitation planning frameworks may enable SLPs to more accurately predict outcomes and individualize interventions that support not only linguistic improvement but also community reintegration and social identity rebuilding.

References

- Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine* (1982), 51(6), 843–857.
- Boden-Albala, B., Litwak, E., Elkind, M. S. V., Rundek, T., & Sacco, R. L. (2005). Social isolation and outcomes post stroke. *Neurology*, 64(11), 1888–1892.
- Brissette, I., Cohen, S., & Seeman, T. E. (2000). Measuring social integration and social networks. In S. Cohen (Ed.), *Social Support Measurement and Intervention* (Vol. 345, pp. 53–85). Oxford University Press.
- Cornwell, B., Schumm, L. P., Laumann, E. O., & Graber, J. (2009). Social Networks in the NSHAP Study: rationale, measurement, and preliminary findings. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 64 Suppl 1(Supplement 1), i47-55.
- Hilari, K., Lamping, D. L., Smith, S. C., Northcott, S., Lamb, A., & Marshall, J. (2009). Psychometric properties of the Stroke and Aphasia Quality of Life Scale (SAQOL-39) in a generic stroke population. *Clinical Rehabilitation*, 23(6), 544–557.
- Kelly, M. E., Duff, H., Kelly, S., McHugh Power, J. E., Brennan, S., Lawlor, B. A., & Loughrey, D. G. (2017). The impact of social activities, social networks, social support and social relationships on the cognitive functioning of healthy older adults: a systematic review. *Systematic Reviews*, 6(1), 259.
- Kertesz, A. (2007). *Western Aphasia Battery--Revised*. <https://doi.org/10.1037/t15168-000>
- Liu, X., Lin, S., Jiang, S., Chen, M., & Li, J. (2023). Social support acquisition in online health communities: a social capital perspective. *Internet Research*, 33(2), 664–695.
- Northcott, S., Moss, B., Harrison, K., & Hilari, K. (2016). A systematic review of the impact of stroke on social support and social networks: associated factors and patterns of change. *Clinical Rehabilitation*, 30(8), 811–831.
- Vickers, C. P. (2010). Social networks after the onset of aphasia: The impact of aphasia group attendance. *Aphasiology*, 24(6–8), 902–913.

Acknowledgments

This work was supported by the NIH/NIDCD Institutional Training Grant T32 DC014435 and the P50 DC014664. Submitted as a Scientific Paper Proposal for AoA 2025.

Figure 1. Average Network Degree, Closeness, Density, and Alter Closeness in PWA.

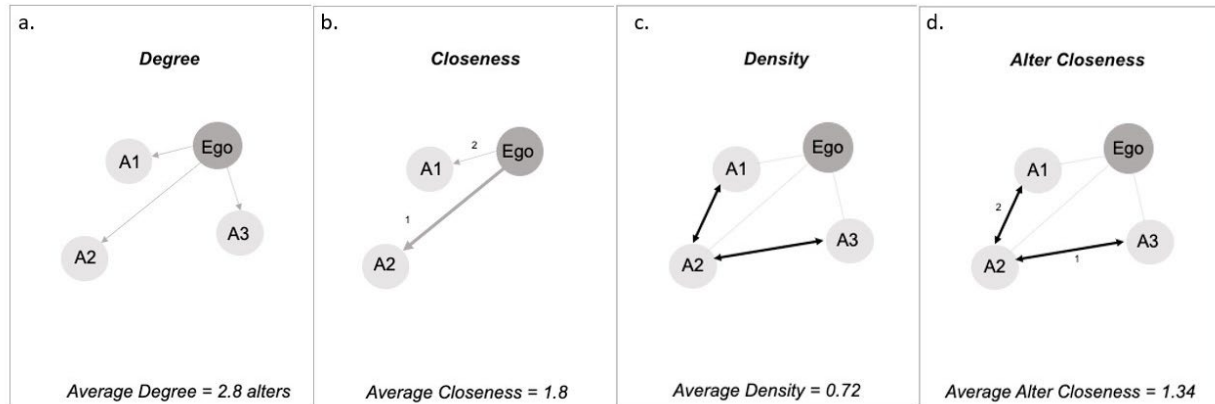


Table 1. Linear Regression Analysis Predicting Closeness

Predictor	Estimate	Std. Error	t-value	p-value
Intercept	1.422	0.671	2.119	0.0410*
Fluency (Fluent = 1)	0.925	0.354	2.613	0.0130*
Sex (Male = 1)	-0.313	0.318	-0.985	0.3313
Stroke Age	-0.029	0.011	-2.539	0.0156*
WAB-R AQ	-0.038	0.193	-0.201	0.8419
Social Support	0.344	0.151	2.278	0.0288*
SAQOL-39	-0.191	0.165	-1.153	0.2563

Note. Significance levels are indicated as follows: * $p < 0.05$, ** $p < 0.01$

Exploring Verb Production Difficulties in Bilingual People with Post-Stroke Aphasia

Silvia De Marchi Hargrove^{1*} and Mira Goral¹

¹ Speech-Language-Hearing Sciences, Lehman College and the Graduate Center, The City University of New York, New York, NY, USA

*Silvia De Marchi Hargrove, sdemarchi@gradcenter.cuny.edu

Introduction

Agrammatic/non-fluent aphasia is characterized by impaired verb morphology, with tense marking typically more impaired than agreement (Fyndanis et al., 2012). Recently, the Synergetic Processing Bottleneck (SPB) model was proposed to explain how different morphosyntactic, phonomotor, and processing limitations contribute to agrammatism in non-fluent aphasia (Faroqi-Shah, 2023). This study aims to test the contributions of the different components of the SPB model by responding to these questions: 1. Is verb retrieval difficulty dissociable from conjugation impairment? 2. Is retrieval combined with conjugation harder than retrieval or conjugation alone? 3. Do error patterns reflect language-specific or aphasia-related traits?

Methods

Five bilingual Spanish-English participants with mild-to-moderate chronic non-fluent aphasia (see Table 1) were tested in both their languages across three tasks. To evaluate verb retrieval, participants completed an action-naming task featuring 27 illustrations from the Verb and Sentence Test (VAST, Bastiaanse et al., 2002). Verb conjugation across three tenses was assessed using 27 stimuli from a verb inflection task developed by Faroqi-Shah (unpublished). A semi-spontaneous narrative task was administered to examine verb retrieval and conjugation during connected language production. Performance on each task was evaluated for accuracy, error frequency, and error type. In the action naming task, responses were categorized as correct verb, incorrect verb, or other (e.g., no verb). The verb inflection task responses were scored as correct tense and agreement, incorrect agreement, or wrong tense. For the narrative task, utterances were coded according to various metrics, including type token ratio, number and proportion of verbs produced, verb tense and agreement.

Results

To address the first research question, we compared participants' accuracy in verb retrieval and verb conjugation in English and Spanish. In English, four out of five participants performed better in retrieval than conjugation. In Spanish, results varied: two participants had equal scores, two showed higher retrieval accuracy, and one achieved perfect conjugation accuracy. Regarding the second research question, analysis of narratives and the verb inflection task revealed better accuracy of verb conjugation in the narratives than in the structured tasks. For narratives, greater difficulty was noted with English verb conjugation compared to Spanish in two participants, and greater difficulty in Spanish for two participants, with errors primarily involving agreement rather than tense. With respect

to the third research question, our findings suggest language-specific morphosyntactic challenges rather than general aphasia-related deficits.

Conclusion

We observed a dissociation between verb retrieval and conjugation in English, but not in Spanish. This may be attributed to the greater morphological complexity of Spanish, consistent with the Competition Model (Bates & MacWhinney, 1989; Li & MacWhinney, 2012). Additionally, our participants showed greater accuracy with tense than agreement, a result that contrasts with previous findings (Fyndanis et al., 2012). Our findings are consistent only in part with the SPB model that posits that morphosyntactic deficits in agrammatic aphasia emerge from the compounded demands of lexical, phonological, and morpho-syntactic processing (Faroqi-Shah, 2023).

References

- Bastiaanse, R., Edwards, S., & Rispens, J. (2002). *Verb and Sentence Test (VAST)*. Suffolk: Thames Valley Test Company.
- Bates, E., & MacWhinney, B. (1989). Functionalism and the Competition Model. In B. MacWhinney, & E. Bates, *The crosslinguistic study of sentence processing* (pp. 3-76). New York: Cambridge University Press.
- Faroqi-Shah, Y. (2023). A reconceptualization of sentence production in post-stroke agrammatic aphasia: The Synergistic Processing Bottleneck model. *Frontiers in Language Sciences*, 2, 1118739. <https://doi.org/10.3389/flang.2023.1118739>
- Fyndanis, V., Varlokosta, S., & Tsapkini, K. (2012). Agrammatic production: Interpretable features and selective impairment in verb inflection. *Lingua*, 122(10), 1134–1147. <https://doi.org/10.1016/j.lingua.2012.05.004>
- Li, P., & MacWhinney, B. (2012). Competition Model. In C. A. Chapelle (Ed.), *The Encyclopedia of Applied Linguistics* (1st ed.). Wiley. <https://doi.org/10.1002/9781405198431.wbeal0168>

Table 1. Participants' information

Participants	Age	Sex	Years of education	Years post-stroke	WAB AQ (English)	Etiology	L1	Age of immigration to the US	Age of L2 acquisition	Overall proficiency pre-stroke	Overall proficiency post-stroke
SE02	51	F	14	27 y	82.9	Left CVA	Spanish	N/A	5 y/o	L1: 10/10 L2: 10/10	L1: 7/10 L2: 7/10
SE05	58	F	17	8 m	92.4	Left CVA	Spanish	45	31 y/o	L1: 10/10 L2: 7/10	L1: 5/10 L2: 4/10
SE06	54	F	18	5 y	94.1	Left CVA	English	N/A	3 y/o	L1: 10/10 L2: 10/10	L1: 5/10 L2: 3/10
SE07	74	M	18	1 y	87.5	Left CVA	Spanish	36	14 y/o	L1: 10/10 L2: 9/10	L1: 6/10 L2: 6/10
SE09	54	F	14	1 y	74.8	Left CVA	Spanish	13	13 y/o	L1: 10/10 L2: 10/10	L1: 5/10 L2: 3/10

Unlocking Language Therapy Potential: A Meta-Analysis of CILT Efficacy in Aphasia Recovery Within the RTSS Framework

Denise Y. Harvey,^{1*} Nicole R. Nissim,^{1,2,3} Suravi Sarkar,¹ Kayla Alznauer,¹ Rishi Vas,¹ Zung Pham,¹ Leslie H. Vnenchak,¹ Roy H. Hamilton,¹ Lynn M. Maher,⁴ & H. Branch Coslett¹

¹ Department of Neurology, University of Pennsylvania, Philadelphia, PA, USA

² Moss Research Rehabilitation Institute, Philadelphia, Pennsylvania, 19027

³ Department of Psychological & Brain Sciences, University of North Florida, Jacksonville, Florida, 32224

⁴ Department of Communication Sciences & Disorders, University of Houston, Houston, Texas, 77204

***corresponding author, harveyde@penndmedicine.upenn.edu**

Introduction

Speech-language therapy (SLT) during the post-stroke period—a time of significant neuroplasticity—is crucial for the recovery of language function (Watila & Balarabe, 2015). We focus on an impairment-based intervention: Constraint Induced Language Therapy (CILT), alternatively known as Constraint Induced Aphasia Therapy (CIAT) or Intensive Language-Action Therapy (ILAT; e.g., Pulvermüller et al., 2001). CILT has garnered considerable interest due to its potential therapeutic benefits (Raymer & Roitsch, 2023). However, CILT protocols vary, making it difficult to discern how to optimally administer CILT and, in turn, for whom this behavioral intervention would be best suited. The Rehabilitation Treatment Specification System (RTSS) serves to establish a systematic approach to delineating the relationship between the parameters of a given treatment and their roles in therapy (Van Stan et al., 2019). Using this framework, we aimed to determine the efficacy of CILT by conducting a systematic review and meta-analysis on previously published research.

Methods

This meta-analysis addresses the following questions:

1. Does CILT confer improvements in global and/or other language abilities (i.e., naming, comprehension, repetition, spontaneous speech, self-/caregiver-reported measures of functional communication)?
2. If CILT is effective for one (or more) aspect(s) of language, does CILT confer maintenance of generalization to treated and/or untreated items in that (those) domain(s)?
3. What are the key ingredients (e.g., treatment regimen, restraint vs. constraint, treatment target) that account for treatment gains following CILT?

Systematic searches were conducted between May 2022 and October 2024 using PubMed, Embase, Web of Science, and Google Scholar. Study inclusion criteria required assessment of CILT treatment outcomes in PWA. Thirty-seven studies were included in omnibus analyses examining CILT on language outcomes.

Results

Findings revealed CILT confers improvements in global language performance up to 12-weeks post-CILT ($d = .27$; $p < 0.001$) and person-reported outcomes ($d = .54$, $p < .001$). Comparison of language functions revealed the greatest gains for naming ($d = .36$, $p < .001$), with a greater effect for treated vs. untreated items ($d = .65$, $p < .001$). However, untreated items displayed a significant, positive effect that was maintained up to 12-weeks post-CILT ($d = .09$, $p < .001$). Moderator analyses exploring the impact of each treatment regimen factor—dose (total # of treatment hours), intensity (# of treatment hours/week), and frequency (# of treatment days/week)—while controlling for the other regimen factors suggested higher doses positively associated with language gains ($d = .01$, $p = .03$). Intensity negatively associated with treatment gains ($d = -.02$, $p < .001$), while frequency did not associate with CILT-induced improvements ($p > .05$). There were no effects of restraint or complexity of target responses (single versus multiword utterances) on CILT outcomes (p 's $> .30$).

Conclusions

Results from this meta-analysis suggest (1) CILT confers clinically meaningful gains in various language aspects with up to 12 weeks of treatment maintenance; (2) gains are most beneficial to word retrieval for trained and untrained items; (3) CILT dose, but not intensity or frequency, impacts treatment efficacy. Findings highlight critical CILT ingredients that impact treatment outcomes.

References

- Pulvermüller, F., Neininger, B., Elbert, T., Mohr, B., Rockstroh, B., Koebbel, P., & Taub, E. (2001). Constraint-induced therapy of chronic aphasia after stroke. *Stroke*, 32(7), 1621-1626.
- Raymer, A. M., & Roitsch, J. (2023). Effectiveness of constraint-induced language therapy for aphasia: Evidence from systematic reviews and meta-analyses. *American Journal of Speech-language Pathology*, 32(5S), 2393-2401.
- Van Stan, J. H., Dijkers, M. P., Whyte, J., Hart, T., Turkstra, L. S., Zanca, J. M., & Chen, C. (2019). The rehabilitation treatment specification system: Implications for improvements in research design, reporting, replication, and synthesis. *Archives of Physical Medicine and Rehabilitation*, 100(1), 146-155.
- Watila, M. M., & Balarabe, S. A. (2015). Factors predicting post-stroke aphasia recovery. *Journal of the Neurological Sciences*, 352(1–2), 12–18.

Acknowledgments

This work was supported by the National Institute on Deafness and Other Communication Disorders [grant number R01 DC016800].

Using Flick Input to Address Typing Impairment in a Japanese-Speaking Person with Aphasia: A Case-Based Intervention

Kosei Hashimoto^{1, 3*}, Koji Yamada^{1, 3}, and Shin Arai^{2, 3}

¹ Department of Speech, Language and Hearing, Mejiro University, Saitama, Japan

² Department of Rehabilitation, Kawakita Medical Foundation Ai Geriatric Health Services Facility, Tokyo, Japan

³ Inclusive and Multifunctional Daycare Services, Heart & Art Diary, Saitama, Japan

*corresponding author, ko.hashimoto@mejiro.ac.jp

Introduction

Aphasia often impairs not only speech and writing but also typing abilities (Lee et al., 2024; Obermeyer et al., 2024). According to OECD reports (2023, 2024), in developed countries, computers are used in nearly all workplaces, and typing is considered a core digital skill. Thus, typing difficulties can be a substantial barrier to workplace reintegration. In Japanese, typing typically involves entering romanized phonemes to produce hiragana, which are then converted into kanji (e.g., *taka* → たか → 鷹 “eagle”). In this case, phoneme-to-romaji conversion was impaired, complicating key selection. Accordingly, an intervention was attempted using flick input—a smartphone-based method familiar to Japanese users.

Case Presentation

The patient was a 45-year-old right-handed man previously employed in sales. A CT scan confirmed a left putaminal hemorrhage, and rehabilitation for right hemiparesis and aphasia began on day 3. At intervention, two years had passed since onset. He needed to regain PC operation and text input skills to return to work. Before the stroke, he had minimal typing experience and was not a touch typist. After onset, he had not used a keyboard but remained able to compose short texts using flick input on his smartphone. At baseline, he correctly wrote 18/20 morae in hiragana, 6/20 in romaji, and 13/20 via typing.

Intervention

Three 16-word sets were prepared: typing training words, flick input training words, and untrained words. Words were selected to represent a full range of Japanese moraic structures. Half had a basic mora-to-character correspondence (e.g., *sekai* → せかい/世界 “world”); the other half included special morae (e.g., *syokki* → しょっき/食器 “tableware”). Flick input allows character selection by sliding in specific directions from each key. We used *FlickKeyboard*, free PC software that simulates flick inputs via mouse. The patient received 18 typing and 13 flick-input training sessions. Afterward, performance on untrained words and subjective difficulty (1 = hardest, 10 = easiest) were assessed.

Outcome

After six typing sessions, all training words became typable. After 18 sessions, total typing time for the 16 words improved from 14:20 to 10:12. All flick training words were correct from the start; input time improved from 9:53 to 6:20. For untrained words: typing = 11/16 correct, flick = 15/16. For special morae: typing = 3/8, flick = 7/8. Mean response latency (correct): typing = 8.71 ± 12.63 sec, flick = 2.77 ± 1.41 sec ($p = .054$). Total time: typing = 43.33 ± 42.72 sec, flick = 28.43 ± 31.03 sec ($p = .054$). Subjective ease: typing = 3/10, flick = 7/10.

Discussion

The patient's low romaji writing performance suggested a phoneme-to-romaji conversion deficit, likely contributing to his typing impairment. Flick input resulted in higher accuracy and faster performance, potentially due to easier target identification, direct character selection, and pre-existing familiarity. These findings suggest that flick input may serve as an effective alternative typing method for Japanese individuals with aphasia.

References

- Lee, J. B., Obermeyer, J. A., & Bae, Y. (2024). Effects of typing training in individuals with aphasia: A case series. *American Journal of Speech-Language Pathology*, 33(2), 610–626.
- Myers, P. S., & Blum, M. (2023). Training sentence production using typing in people with aphasia: A multiple-baseline study. *American Journal of Speech-Language Pathology*, 32(3), 1143–1157.
- OECD. (2023). OECD City Network on Jobs and Skills 2023. OECD Publishing. <https://www.oecd.org/employment/city-network-jobs-skills.htm>
- OECD. (2024). OECD Digital Economy Outlook 2024 (Volume 1): Embracing the Technology Frontier. OECD Publishing.

Acknowledgments

This work was supported by Japan Society for the Promotion of Science (JSPS) KAKENHI grant number 25K20910.

Figure 1. Number of Correct Responses for Untrained Words. Basic morae refer to standard moraic units in Japanese, typically represented by a consonant-vowel (CV) structure such as ka, shi, or no. Special morae include non-syllabic moraic elements such as the sokuon (e.g., っ), the syllabic nasal (e.g., ん), and long vowels (e.g., ー), which are each counted as one mora despite not forming full syllables.

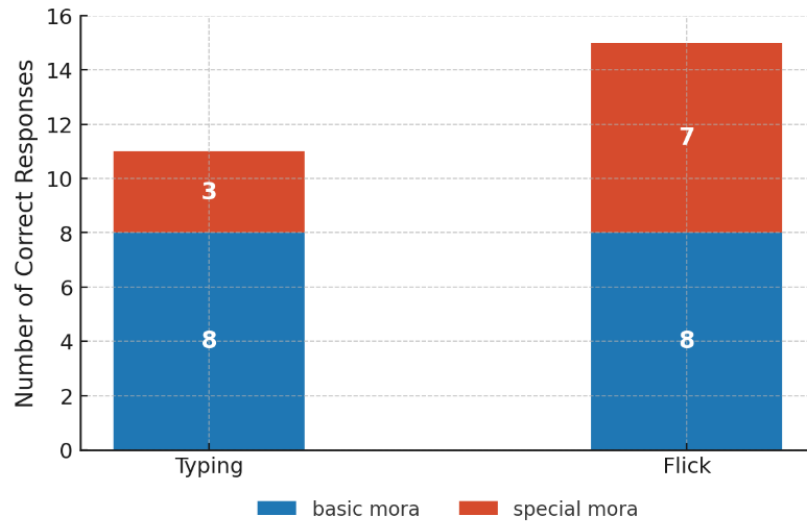
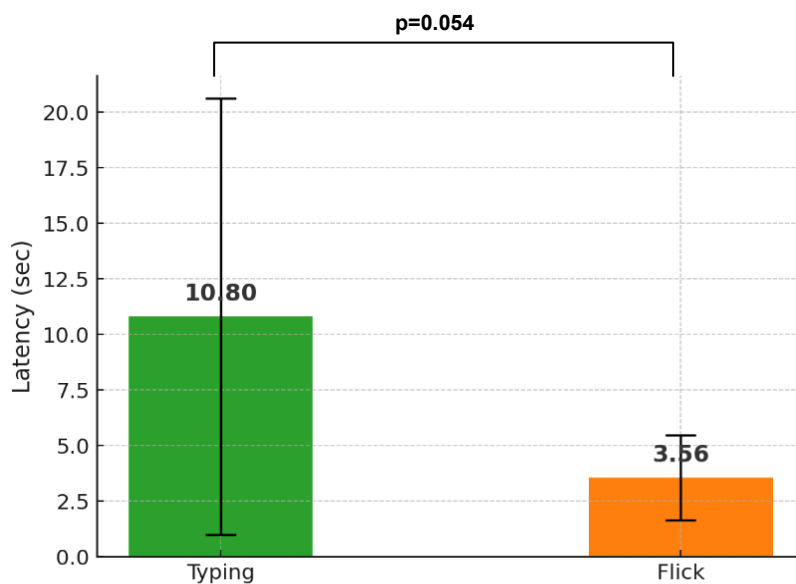


Figure 2. Response Latency for Untrained Words (Mean $\pm$ 95% CI). A statistical comparison was performed using the Wilcoxon sign.



Characterizing neural signatures of Alzheimer's disease and related disorders using functional near infrared spectroscopy

Shalom K. Henderson^{1*}, Shannon Kelley², Berk Tellioglu¹, Erie Shivers¹,
Meryem Yucel², David Boas², and Swathi Kiran¹

¹ Center for Brain Recovery, Boston University, Boston, MA, USA

² Neurophotonics Center, Boston University, Boston, MA, USA

*Corresponding author, skh51@bu.edu

Introduction

Functional near-infrared spectroscopy (fNIRS) – a neuroimaging technique that measures cortical hemodynamic responses by tracking changes in oxygenated and deoxygenated hemoglobin (Zimmermann et al., 2019) – offers a **portable, cost-effective, and movement-tolerant** alternative to the traditional MRI, making it especially well-suited for aging and neurodegenerative conditions like Alzheimer's disease (AD). While previous fNIRS studies in AD have primarily focused on constrained tasks like naming (Kim et al., 2021), current research is moving towards **naturalistic, discourse-based paradigms** that better reflect everyday communication challenges. This shift is crucial as discourse tasks engage broader cognitive and language networks and may offer more sensitive biomarkers of functional decline in AD and related disorders (ADRD). In this study, we used **fNIRS** to examine real-time cortical activity in ADRD during naturalistic discourse. We hypothesized that individuals with ADRD would show **reduced fNIRS signal amplitude** in language-relevant cortical regions compared to healthy adults during naturalistic discourse production.

Methods

Twelve participants with Alzheimer's disease (McKhann et al., 2011) or mild cognitive impairment, and **15 old healthy** adults participated in the study. Cortical activity was recorded using the **NIRx NIRSport2 system**, configured with **16 sources and 16 detectors**, and the probe comprised of 37 long separation and eight short separation channels (Yucel et al., 2015). Participants completed a discourse task responding to general and personal prompts in the experimental condition, and repeating experimenter-provided sentences in the control condition. The **primary regions of interest (ROIs)** included the **left middle frontal gyrus** and **bilateral frontal, temporal, and parietal cortices**. The **bilateral precentral gyri** served as control regions. Estimated **oxygenated hemoglobin (HbO) values were averaged within conditions and groups**. **Mixed-effects models** examined the interaction between group (ADRD vs. control) and condition (experimental vs. control) in predicting changes in **HbO** within each ROI.

Results

In the left frontal ROI, there was an effect of condition ($B < .001$, $SE < .001$, $t = 4.16$, $p < .001$) and a group-by-condition interaction ($|B| < .001$, $SE < .001$, $t = -2.61$, $p = .02$), driven by greater HbO in healthy controls for the experimental condition ($p = .001$). The left

temporal ($B < .001$, $SE < .001$, $t = 2.08$, $p = .05$) and parietal ($B < .001$, $SE < .001$, $t = 1.92$, $p = .05$) ROIs also showed main effects of condition, though pairwise comparisons were non-significant. *Post hoc* analysis revealed greater HbO in the experimental vs. control condition for the dementia group in the left parietal ROI ($p = .04$).

Conclusions

Healthy controls showed increased left frontal activation during discourse production, replicating prior findings of task-related recruitment with higher cognitive-linguistic demands. In contrast, individuals with ADRD showed reduced fNIRS signal amplitude, supporting diminished neural engagement during natural language use. This is the first fNIRS study to include atypical AD phenotypes such as the logopenic variant of primary progressive aphasia (Graff-Radford et al., 2021), highlighting fNIRS as a practical tool for capturing language functions in diverse clinical populations. Ongoing work is expanding to larger cohorts, varied discourse tasks, and brain-behavior correlations.

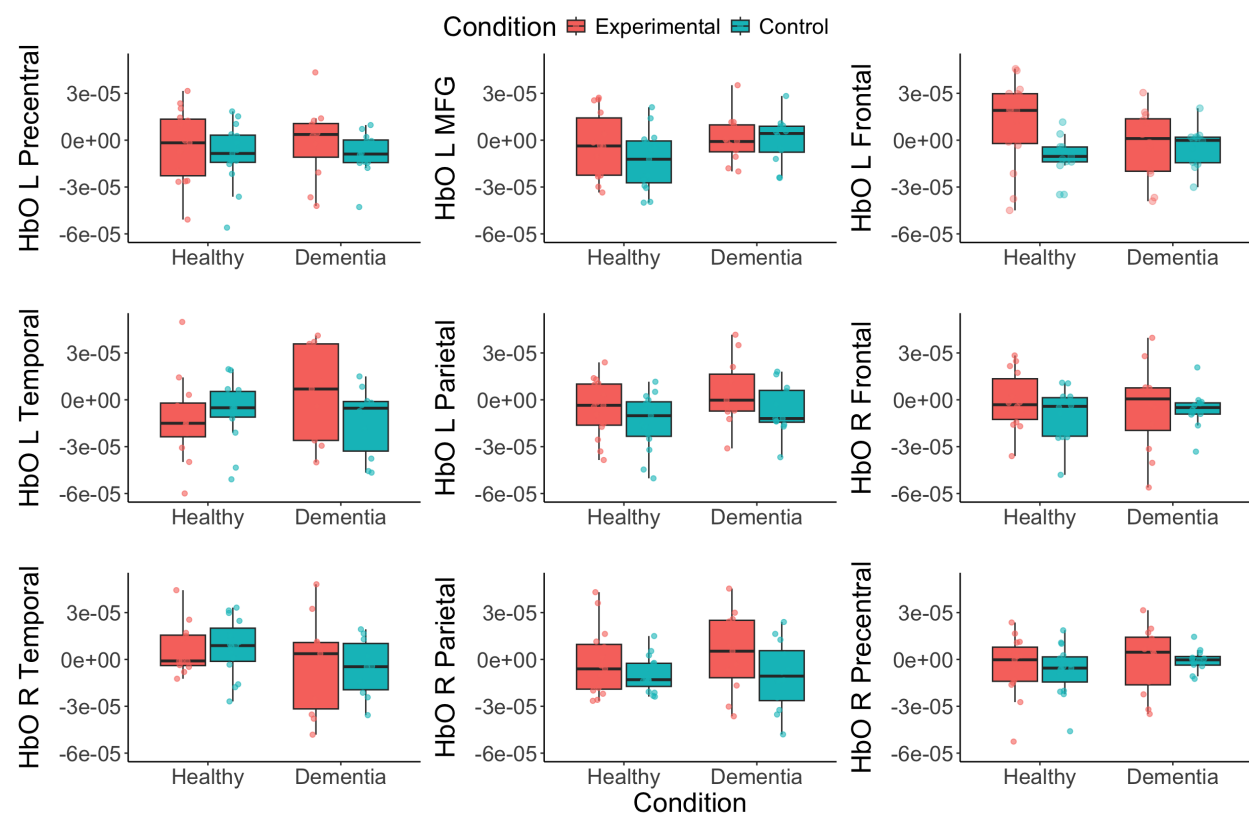
References

- Graff-Radford, J., Yong, K. X. X., Apostolova, L. G., Bouwman, F. H., Carrillo, M., Dickerson, B. C., Rabinovici, G. D., Schott, J. M., Jones, D. T., & Murray, M. E. (2021). New insights into atypical Alzheimer's disease in the era of biomarkers. *Lancet Neurology*, 20(3), 222-234.
- Kim, E., Yu, J. W., Kim, B., Lim, S. H., Lee, S. H., Kim, K., Son, G., Jeon, H. A., Moon, C., Sakong, J., & Choi, J. W. (2021). Refined prefrontal working memory network as a neuromarker for Alzheimer's disease. *Biomed Optics Express*, 12(11), 7199-7222.
- McKhann, G. M., Knopman, D. S., Chertkow, H., Hyman, B. T., Jack, C. R., Jr., Kawas, C. H., Klunk, W. E., Koroshetz, W. J., Manly, J. J., Mayeux, R., Mohs, R. C., Morris, J. C., Rossor, M. N., Scheltens, P., Carrillo, M. C., Thies, B., Weintraub, S., & Phelps, C. H. (2011). The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers & Dementia*, 7(3), 263-269.
- Yucel, M. A., Selb, J., Aasted, C. M., Petkov, M. P., Becerra, L., Borsook, D., & Boas, D. A. (2015). Short separation regression improves statistical significance and better localizes the hemodynamic response obtained by near-infrared spectroscopy for tasks with differing autonomic responses. *Neurophotonics*, 2(3), 035005.
- Zimmermann, B. B., Tamborini, D., Selb, J., Martinez, A. O., & Boas, D. A. (2019, 2019/04/14). Development of a Wearable fNIRS System Using Modular Electronic Optodes for Scalability. *OSA Technical Digest Biophotonics Congress: Optics in the Life Sciences Congress 2019 (BODA,BRAIN,NTM,OMA,OMP)*, Tucson, Arizona.

Acknowledgments

We sincerely thank our patients and their families for supporting this work.

Figure 1. Estimated HbO averages for individuals with dementia (N = 12) and healthy controls (N = 15) during the interaction task.



A crossover case study of two phonological treatments for anomia: Phonological Components Analysis and Phonomotor Treatment

Molly Holcombe¹, Gabrielle Vasi¹, Peyton Tripp¹, Sofia Sozio¹, Hannah Meltzer¹, & Nichol Castro^{1*}

¹ Communicative Disorders and Sciences, University at Buffalo, Buffalo, New York, USA

***corresponding author, nicholca@buffalo.edu**

Introduction

Many people with aphasia receive anomia treatment, with several efficacious options available (Laine & Martin, 2024). Current work examining *which* anomia treatment someone should receive has largely compared semantic-focused and phonological-focused anomia treatments (Shekhar et al., 2024; Haentjens & Auclair-Ouellet, 2021; van Hees et al., 2012; Kendall et al., 2019). However, a comparison of treatment options *within a linguistic domain* is not often considered. We present a crossover case study of one participant who received Phonological Components Analysis (PCA) (Leonard et al., 2008) and Phonomotor Treatment (PMT; Kendall et al., 2008). While both treatments improve anomia by targeting phonological processes, they do so through different mechanisms of action (Castro et al., 2024).

Methods

The participant was a retired, 72-year-old Black male who communicates using English, with no vision or hearing impairments. He presents with moderate aphasia based on WAB AQ (Kertesz, 1982). Phonemic paraphasias and mild apraxia of speech were noted. Performance on the CLQT+ indicated mild non-linguistic cognitive impairment (Helm-Estabrooks, 2001).

There were two treatment phases separated by an 8-week break. PCA, a guided cueing approach to retrieving target words, was administered in phase one following Leonard et al. (2015). PMT, a multi-modal treatment focused on the perception, production, and manipulation of phonemes and phoneme sequences, was administered in phase two following Kendall and Nadeau (2016). Each phase consisted of pre- and post-treatment testing. There were 20 hours of PCA and 28 hours of PMT delivered.

The primary outcome measures were confrontation naming and Standardized Assessment of Phonology in Aphasia (SAPA; Kendall et al., 2010), chosen based on relevance to the treatments: PCA includes naming and PMT includes phonological awareness tasks. Confrontation naming was completed three times at pre- and post-treatment timepoints using an in-house naming battery (n = 310 pictures). Naming performance at the first pre-treatment timepoint was used to identify target words for treatment (n = 40), which were randomized to treatments (n = 20 per treatment), and non-target words (n = 270).

Results

Repeated measures ANOVA indicated an interaction between time and word group, $p < .0001$ (Figure 1). Post-hoc analyses indicated improved naming accuracy from pre- to

post-PCA on target words assigned to PCA, $p < .0001$, but there was a decline in naming accuracy of these words from post-PCA to pre-PMT, $p = .018$. The participant did not demonstrate change in naming accuracy from pre- to post-PMT for any word groups. Table 1 provides the SAPA data. There was an increase in total scores from pre-PCA to pre-PMT (i.e., +3 points) and from pre-PMT to post-PMT (i.e., +6 points). Gains were found in Subtests 1 and 3.

Conclusions

The participant demonstrated improvement after both phonological-focused anomia treatments. Significant improvement was seen in confrontation naming of trained words immediately after PCA. Limited gains after PMT may be due to study design, including low dosage and, subsequently, limited progression to complex stimuli (i.e., longer sequences and real words). Nevertheless, gains on SAPA, as well as no decline in naming, are promising indicators of PMT response.

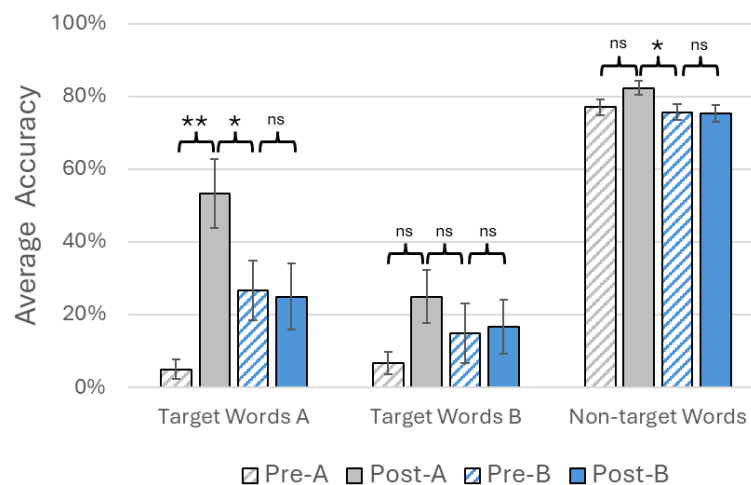
More single-subject, crossover studies are needed to advance our understanding of who benefits from which treatment, particularly within a linguistic domain. These results provide evidence of feasibility for such a larger study.

References

- Castro, N., Braun, E.J., Warner, L. (2024). *A scoping review of phonological treatments for anomia*. Academy of Aphasia [Poster Presentation; Manuscript revision under review].
- Haentjens, K., & Auclair-Ouellet, N. (2021), Naming gains and within-intervention progression following semantic feature analysis (SFA) and phonological components analysis (PCA) in adults with chronic post-stroke aphasia. *Aphasiology*, 35, 1024–1047.
- Helm-Estabrooks, N. (2001). *Cognitive linguistic quick test: CLQT*. Psychological Corporation.
- Kendall, D.L., del Toro, C., Nadeau, S., Johnson, J., Rosenbek, J., & Velozo, C. (2010) The development of a standardized assessment of phonology in aphasia. *Clinical Aphasiology*
- Kendall, D.L., & Nadeau, S.E. (2016). The phonomotor approach to treating phonological-based language deficits in people with aphasia. *Topics in Language Disorders*, 36, 109–122.
- Kendall, D.L., Rosenbek, J.C., Heilman, K.M., Conway, T., Kleinberg, K., Rothi, L.J.G., & Nadeau, S. (2008). Phoneme-based rehabilitation of anomia in aphasia. *Brain & Language*, 105, 1–17.
- Kendall, D.L., Oelke Moldestad, M., Allen, W., Torrence, J., & Nadeau, S.E. (2019). Phonomotor versus Semantic Feature Analysis treatment for anomia in 58 persons with aphasia: A Randomized Controlled Trial. *Journal of Speech, Language and Hearing Research*, 6.
- Kertesz, A. (1982). *Western Aphasia Battery test manual*. Psychological Corporation.
- Laine, M., & Martin, N. (2024) *Anomia: Theoretical and Clinical Aspects*, 2nd ed. Routledge.
- Leonard, C., Laird, L., Burianová, H., Graham, S., Grady, C., Simic, T., & Rochon, E. (2015). Behavioural and neural changes after a “choice” therapy for naming

- deficits in aphasia: preliminary findings. *Aphasiology*, 29, 506–525.
- Leonard, C., Rochon, E., & Laird, L. (2008). Treating naming impairments in aphasia: Findings from a phonological components analysis treatment. *Aphasiology*, 22, 923–947.
- Shekari, E., Mehrpour, M., Joghataei, M., Modarrees Zadeh, A., Valinejad, V., Adineg, H., Seyfi. M., & Goudarzi, S. (2024) Focusing on the locus of the breakdown for treatment of anomia: A pilot study. *Clinical Linguistics & Phonetics* 38, 477–507.
- Van Hees, S., Angwin, A.J., McMahon, K.L., & Copland, D.A. (2012). A comparison of semantic feature analysis and phonological components analysis for the treatment of naming impairments in aphasia. *Neuropsychological Rehabilitation*, 23, 102–132.

Figure 1. Confrontation Naming Accuracy Pre- and Post- Treatments for Target and Non-Target Words



Note: A = PCA, B = PMT; * = $p < .05$, ** = $p < .0001$, ns = $p > .05$. The interaction between Time and Word Group was significant, $F(6, 921) = 6.66$, $p < .0001$. Only some simple main effects are reported for clarity.

Table 1. Standardized Assessment of Phonology in Aphasia (SAPA) Scores Pre- and Post-Treatments.

	PCA		PMT	
	Pre-Tx	Post-Tx	Pre-Tx	Post-Tx
Subtest 1: Reading (max = 52)	26 (50.0%)		26 (50.0%)	30 (57.7%)
Subtest 2: Auditory Phonological Processing (max = 59)	48 (81.4%)		49 (83.1%)	48 (81.4%)
Subtest 3: Repetition, Parsing, Blending (max = 33)	10 (30.3%)		12 (36.4%)	15 (45.5%)
SAPA Total (max = 144)	84 (58.3%)		87 (60.4%)	93 (64.6%)

Note: Due to scheduling, the SAPA was not readministered post-PCA treatment.

Beyond Accuracy: Naming Error Patterns Following Therapy in Hebrew-Speaking Individuals with Post-Stroke Aphasia

Yuval Homsy^{1, 2, 3}, Tammar Truzman^{4*}, and Tali Bitan^{2, 3, 5, 6}

¹ Cognitive Sciences, University of Haifa, Haifa, Israel

² The Institute of Information Processing and Decision Making (IIPDM), Haifa, Israel

³ The Integrated Brain and Behavior Research Center (IBBRC), Haifa, Israel

⁴ MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge, United Kingdom

⁵ Psychology, University of Haifa, Haifa, Israel

⁶ Speech Language Pathology, University of Toronto, Toronto, Canada

***corresponding author, truzmant@gmail.com**

Introduction

Our previous study (Truzman et al., 2023) demonstrated that a morphology-based naming therapy, tailored to Hebrew's root-and-template structure, improves naming accuracy and generalizes to untreated words. However, that analysis relied solely on binary correct/incorrect outcomes, potentially overlooking meaningful changes in the nature of naming attempts. A key open question remains: Was the improvement in naming due to enhanced morphological sensitivity and the use of decomposition as a retrieval strategy, or did therapy simply strengthen the representation of treated words, leading to generalization through spreading activation? To address this, we conducted a detailed error-type analysis to capture the evolving profile of naming behavior during and after treatment.

Methods

Twelve individuals with chronic post-stroke aphasia completed 20 sessions of morphology-based naming therapy over 10 weeks. The treatment focused on producing morphologically complex Hebrew words by activating root-template structures. A 60-item test of bimorphemic nouns was administered at baseline, immediately after treatment, and again at a 10-week follow-up. Naming responses were manually classified into linguistic error categories: semantic, phonological, morphological, neologisms, hesitations, and others. Generalized linear mixed-effects models (GLMMs), conducted separately for error counts of each type, were used to examine how they changed across tests, separately for treated and untreated words. Fixed effects included time(sessions), word frequency, and word length (no. of syllables), with random intercepts for participants and items. Planned pairwise comparisons were conducted using Bonferroni corrections.

Preliminary Results

Full results will be available at the time of the conference.

Preliminary results from nine participants revealed distinct patterns in naming errors. Overall error counts, summed across categories, showed a significant reduction from pre- to post-treatment for both treated and untreated words (Wilcoxon test; $p < .05$), indicating a genuine therapeutic effect rather than a mere shift between error types. GLMM analyses

further revealed that, for treated words, semantic, phonological, and hesitation errors significantly decreased from pre- to post-treatment ($p < .05$), with these improvements maintained at follow-up. Notably, morphological errors, i.e., responses consisting of real words that shared the root of the target and conveyed overlapping semantic and phonological information, significantly increased in untreated words post-treatment ($p < .05$), suggesting emerging use of morphological decomposition as a compensatory retrieval strategy.

Conclusions

Our previous findings showed that morphology-based therapy effectively improves naming accuracy in people with aphasia. The current analysis offers further insight into the mechanisms underlying this improvement. The post-treatment rise in morphological errors, responses that shared the root with the target word, suggests enhanced morphological processing and active engagement of complex word decomposition during lexical retrieval. Importantly, such responses often conveyed sufficient meaning to imply the target and to support effective communication, underscoring their potential real-world value. These patterns reflect a dynamic reorganization of lexical retrieval strategies, aligned with the therapy's goals. Concurrent decreases in hesitation, phonological, and semantic errors indicate more efficient lexical access, benefits not captured by binary accuracy measures alone. Overall, this analysis highlights the value of detailed error profiling for optimizing aphasia therapy.

References

Truzman, T., Biran, M., Soikher, E., Soroker, N., Levy, T., & Bitan, T. (2023) A Novel Morphology-Based Naming Therapy for People with Aphasia, *Aphasiology*. DOI: 10.1080/02687038.2023.2257354

Prosodic Cues Utilization for Syntactic and Pragmatic Ambiguity Resolution Among Mandarin-Speaking People with Aphasia

Yi Hu^{1,2} and Haiyan Wang^{1,2*}

¹ School of Foreign Languages, Shanghai Jiao Tong University, Shanghai, China

² National Research Center for Language and Well-Being, Shanghai Jiao Tong University, Shanghai, China

*corresponding author, haiyan.wang@sjtu.edu.cn

Introduction

Linguistic prosody refers to the rhythm, stress, and intonation patterns in speech that contribute to the interpretation of meaning beyond lexical content (Price et al., 1991). Both syntactic and pragmatic prosodic cues play crucial roles in guiding listeners through structural ambiguities and in conveying speaker intentions during communication. People with aphasia (PWA) often experience deficits in processing linguistic prosody, which can significantly disrupt effective communication (Pell & Baum, 1997). However, it remains unclear whether and how Mandarin-speaking PWA are impaired in their comprehension of linguistic prosody (de Beer et al., 2023). The present study investigated prosodic processing in this population, focusing on their interpretation of syntactic and pragmatic prosody. Experiment 1 examines to what extent PWA utilize prosodic stress to resolve syntactic ambiguities caused by focus particle *zhiyou* ‘only’. Experiment 2 explores PWA’s use of intonation cues to interpret pragmatic ambiguities introduced by *shenme* ‘what’.

Methods

Ten Mandarin-speaking PWA (5F/5M; $M_{age} = 51.0$; $M_{edu} = 8.0$; $M_{AQ} = 62.44$) and 13 age- and education-matched healthy controls (HC; 6F/7M; $M_{age} = 50.5$; $M_{edu} = 7.0$) participated in two experiments. In Experiment 1, participants listened to sentences structured as ‘*zhiyou* + modifier + *DE* + head noun + propositional phrase’ (e.g., only the girl’s clock is inside the box). Syntactic ambiguities were disambiguated by prosodic stress placed either on the modifier ($n = 16$) or the head noun ($n = 16$). In Experiment 2, participants heard two types of pragmatically ambiguous sentences: (i) ‘NEG-V-*shenme*-N’ which could be declarative or interrogative, and (ii) ‘V-*shenme*-N’ which could be imperative or interrogative. The two kinds of readings were disambiguated by either level intonation ($n = 32$) or rising intonation ($n = 32$). For each trial, participants judged whether the auditory sentence matched a corresponding picture shown on the screen.

Results

In Experiment 1, PWA demonstrated significantly lower accuracy than HC in syntactic prosody comprehension, exhibiting no clear differentiation between the modifier- and head noun-stressed conditions (see Figure 1), suggesting reduced sensitivity in integrating prosodic stress cues with syntactic focus. In Experiment 2, PWA also showed lower overall accuracy than HC in pragmatic prosody interpretation, particularly in rising intonation. PWA’s performance was also modulated by sentence types. Specifically, they performed better on simpler V-*shenme*-N structures than on more complex NEG-V-

shenme-N structures, suggesting further impairment caused by increased processing demands. Additionally, PWA's accuracy in both experiments was significantly predicted by their cognitive abilities, particularly attention and working memory.

Conclusions

This study demonstrates that Mandarin-speaking PWA exhibit significant impairments in prosodic processing across both syntactic and pragmatic domains. In Experiment 1, they failed to use stress cues to distinguish focus interpretations, indicating deficits in syntactic prosody comprehension. In Experiment 2, their difficulty was particularly evident when rising intonation signaled interrogative intent, with performance further influenced by processing difficulties. These findings suggest that prosodic deficits in aphasia extend beyond lexical or segmental processing and may be related to broader cognitive declines. The results highlight the need for interventions that support the integration of prosodic, syntactic, and pragmatic information.

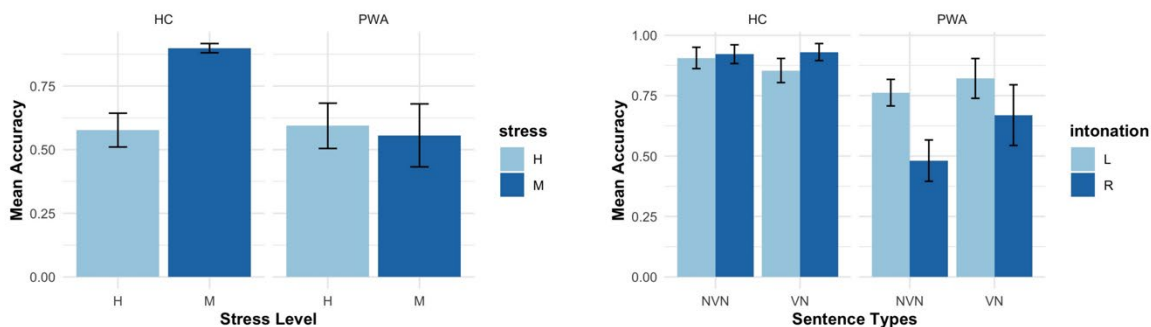
References

- Pell, M. D., & Baum, S. R. (1997). The Ability to Perceive and Comprehend Intonation in Linguistic and Affective Contexts by Brain-Damaged Adults. *Brain and Language*, 57(1), 80–99.
- Price, P. J., Ostendorf, M., Shattuck-Hufnagel, S., & Fong, C. (1991). The use of prosody in syntactic disambiguation. *The Journal of the Acoustical Society of America*, 90(6), 2956–2970.
- de Beer, C., Wartenburger, I., Huttenlauch, C., & Hanne, S. (2023). A systematic review on production and comprehension of linguistic prosody in people with acquired language and communication disorders resulting from unilateral brain lesions. *Journal of Communication Disorders*, 101, 106298.

Acknowledgments

This study was supported by the Post Funding Project of the National Social Science Fund [22FYYB043] granted to Haiyan Wang. This submission is part of a workshop.

Figure 1. Mean accuracy for healthy controls (HC) and people with aphasia (PWA) in experiment 1(left panel) and experiment 2 (right panel). *Notes:* H = stress on head noun; M = stress on modifier; L = level intonation; R = rising intonation; NVN = NEG-V-*shenme*-N; VN = V-*shenme*-N



Replicable Error Coding: a Large-scale Automated Coder for Coding Errors in Word Production Tasks

Shanhua Hu^{*1}, Delaney DuVal², Brielle C. Stark², Nazbanou Nozari¹

¹ Department of Psychological and Brain Sciences, Indiana University, Bloomington, Indiana, United States

² Speech, Language and Hearing Sciences Department, Indiana University, Bloomington, Indiana, United States

***corresponding author, sh59@iu.edu**

Introduction

Speech errors have played a monumental role in advancing our understanding of the architecture of the language production system and its disorders, especially in individuals with aphasia (IWA) (e.g., Dell et al., 1997). However, coding large datasets by hand is cumbersome and error-prone. To classify an error, coders must judge the target-error relationship in two key dimensions: *semantic* and *phonological* similarity. The main problem with semantic similarity, especially thematic/associative similarity, is that it can be a subjective judgment. Phonological similarity judgments pose a different problem. Standardized tests like the Philadelphia Naming Test (PNT) have rules for computing phonological similarity that are difficult to memorize and implement easily, and more importantly, these rules may not reflect the cognitive processes most relevant to phonological production. The goal of this project was to harness the advances in distributional semantics and machine coding to build the first automated target-error coder that can be used in any word production task.

Methods

The automated coder used Word2Vec with cosine similarity to measure the semantic similarity and normalized Levenshtein distance (a metric indicating the number of changes required to turn one word into another) to assess phonological similarity between target and error. To train and test the models, two datasets were used: D1 included 12 sessions of PNT from 38 IWA, collected at the University of South Carolina. D2 included 2 sessions of picture naming data on a 444-item battery from 12 IWA collected in the PI's former lab at Johns Hopkins University (Nozari, 2019). Each dataset was independently coded by two human coders following the PNT coding rules. Semantic and phonological thresholds were obtained by training the model on part of each dataset to minimize the discrepancy between machine and human error coding. The model's performance was then tested on the rest of the data. Three sets of analyses were conducted. The first set used 10-fold cross-validation to evaluate overall performance within each dataset, and then across the two datasets. The second set used a Leave-One-Out (LOO) approach to examine generalization to new IWA within and across the two datasets. Finally, the third set also used LOO to examine generalization to new items in D2, where enough item-level repetition was available. Accuracy was defined as the consistency between the machine and human codes.

Results

Overall training accuracy was 89.09% and 88.84% for D1 and D2, respectively. Importantly, testing accuracy had an average of 88.97% within- and 85.69% across-datasets (range: 84.66-90.15%; Fig. 1a). Subject generalization accuracy was also high with an average of 88.07% within- and 85.35% across-datasets (range: 72.94-93.39%; Fig. 1b). Finally, average item-level training and testing accuracy was 89.85% and 87.93%, respectively (Fig. 1c).

Conclusions

The results show that (a) the model's accuracy is close to the accuracy of trained human coders, and (b) it generalizes quite well to new participants and new words. Thus, our coder provides a fast, easy, and replicable coding mechanism that can be used across all research groups interested in working with linguistic error data.

References

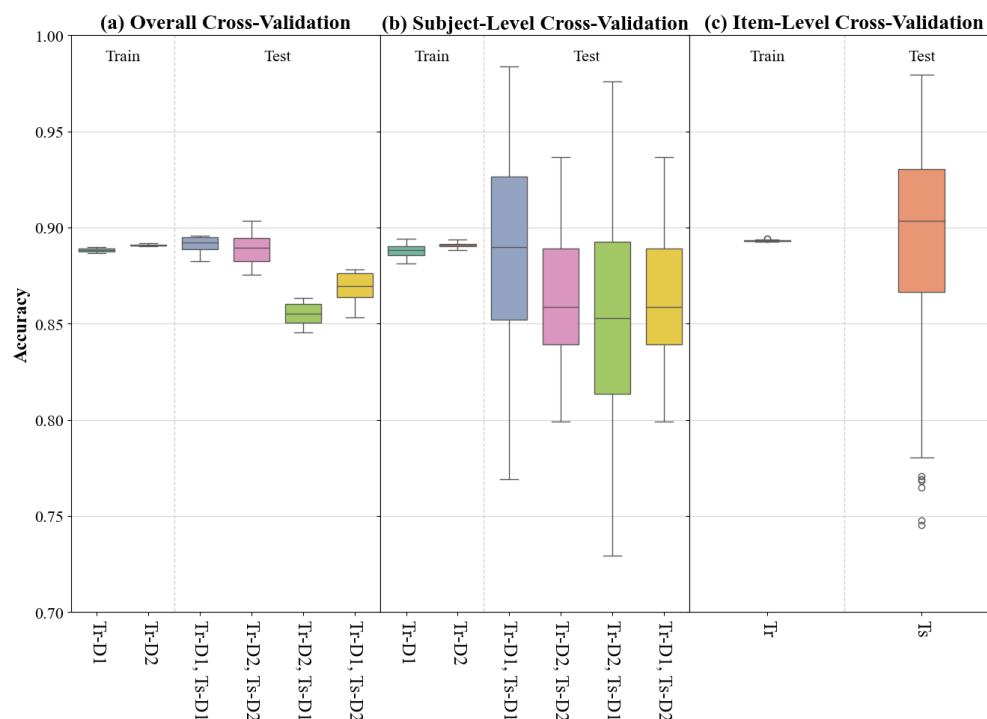
Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological review*, 104(4), 801.

Nozari, N. (2019). The dual origin of semantic errors in access deficit: activation vs. inhibition deficit. *Cognitive Neuropsychology*, 36(1-2), 31-53.

Acknowledgments

We would like to thank Julius Fridriksson and the C-STAR group for sharing their data for model evaluation in this project.

Figure 1. Cross-Validation for Model Performance. Tr = training dataset, Ts = testing dataset. Whiskers show the range.



Democratizing Lesion Symptom Mapping in Aphasia Research with Manual Lesion Segmentation Training

Isabella Huynh^{1*}, Erin Yi¹, Jeremy Yeaton¹, Danielle Fahey²

¹ Department of Language Science, University of California, Irvine (California), USA

² Department of Speech Language and Hearing Sciences, University of Alabama, (Alabama), USA

*Corresponding author: huynhi3@uci.edu

Introduction

Lesion-symptom mapping (LSM) is a technique for investigating the neural underpinnings of language and cognition by linking specific brain lesions to their corresponding behavioral impairments (Vaidya et al., 2019). A prerequisite to LSM is lesion segmentation, for which the gold standard is hand-tracing the outline of a brain lesion onto a three-dimensional magnetic resonance image (MRI). However, accurate lesion segmentation requires high-quality MRIs and expert tracers. To address this, we established a group to facilitate development of lesion segmentation skills using freely available software. Lesion segmentation is not typically part of graduate or medical training, yet it remains critical, especially in large-scale studies (Ferrera et al., 2022). Our aims are to establish and identify the best practices for lesion segmentation training and increase accessibility to this skill, particularly in aphasia research.

Methods

Participants were assigned 11 lesion tracings from the openly available USC ATLAS dataset (Liew et al., 2022). We predominantly selected perisylvian left-hemisphere lesions as these are typically associated with post-stroke language deficits. Prior to the onset of individual tracings, participants received a lesion tracing guide and four T1-weighted MR images with corresponding gold-standard lesion segmentations to familiarize themselves with the software and understand lesion delineation. During the 22-week training period, our group met after completing each segmentation to receive feedback via slice-by-slice visual comparisons of their tracings against the gold standard and their peers. Dice coefficient (DC) calculation was implemented to capture the degree of similarity between participants' tracings and the gold-standard segmentation (Demidenko et al., 2024). Feedback from participants after each scan helped us better understand common challenges and helpful resources, as well as track individuals' confidence in their accuracy.

Results

Participants (N=13) had no experience with manual segmentation, but varied in background and experience (e.g., current educational level: undergraduate to faculty). Across scans 1-4, average accuracy rose from DC=0.48 to DC=0.71, suggesting improved accuracy. Data collection is ongoing. In their feedback surveys, participants reported difficulty differentiating lesion and CSF-filled spaces like ventricles and sulci.

Participants preferred tracing in the axial and coronal planes rather than sagittal, as they found it more challenging to identify cortical landmarks in the sagittal plane. In response to participant feedback, we provided them with an anatomical atlas of healthy MRIs in order to familiarize themselves with healthy brain structures.

Conclusions

At the end of the training period, we will conduct a reliability test of trainees by providing three new lesion samples and comparing them to gold-standard tracings. We expect training and feedback to have improved lesion segmentation accuracy over time and reduce inter-tracer variability. We hope to support the development of similar training programs in other research groups and move the field toward more standardized and accessible training resources for manual lesion segmentation with our findings. In turn, we hope that this can expand the accessibility of LSM in aphasiology and underscore the importance of neuroanatomy to support diagnosis, treatment, and ultimately our understanding the neural underpinnings of language.

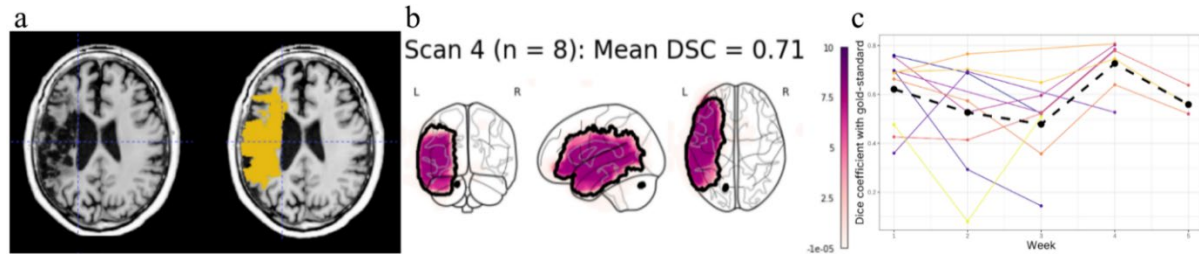
References

- Demidenko M, Mumford J, Poldrack R. *PyReliMRI: An Open-source Python Tool for Estimates of Reliability in MRI Data (2.1.0)* [Computer software]. Zenodo; 2024. doi:10.5281/zenodo.12522260
- Ferrara, C., Coslett, B., & Buxbaum, L. (2022). Manual lesion segmentation. In *Lesion-to-Symptom Mapping: Principles and Tools* (pp. 53–78). Humana.
- Liew, S.-L., et al. (2022). A large, curated, open-source stroke neuroimaging dataset to improve lesion segmentation algorithms. *Scientific Data*, 9(1).
- Vaidya, A. R., & Pujara, M. S., Petrides, M., Murray, E. A., & Fellows, L. K. (2019). Lesion studies in contemporary neuroscience. *Trends in Cognitive Sciences*, 23(8), 653–671.

Acknowledgments

JY was supported by a William Orr Dingwall Dissertation Fellowship. IH & EY received support from the UC Irvine Undergraduate Research Opportunities Program. DF received support from start-up funds at the University of Montana.

Figure 1. (a) The left panel shows the corresponding T1-weighted MRI scan in the axial plane to denote what participants see; the right panel displays the same slice with the gold-standard lesion to illustrate the difficulty participants faced in identifying lesion boundaries. Overlap was quantified using Dice similarity coefficients (DSC) across participants. **(b)** Overlap between participant-drawn lesion segmentations for Scan 4, compared to the gold standard. Colored tracings represent lesion masks manually segmented by individual participants, while the black outline denotes the gold-standard lesion segmentation. **(c)** DSC's across the initial five weeks with each colored line representing a participant. The dashed black line displays the average DSC across all participants for each week.



Recursive Self-feedback Enables Target Language Production in Bilingual Aphasia with Pathological Language Mixing

Gerald C. Imaezue¹, Celine Davis,¹ Krishna Veni Maram², David Ajayi¹, and Mira Goral^{3,4}

¹Department of Communication Sciences and Disorders, University of South Florida, Tampa FL, USA

² Department of Computer Science and Engineering, University of South Florida, Tampa FL, USA

³ Department of Speech, Language and Hearing Sciences, Lehman College, City University of New York, NY, USA

⁴ Speech-Language-Hearing Sciences Program, The Graduate Center, City University of New York, NY, USA

*Corresponding author, gimaezue@usf.edu

Introduction

Stroke-related damage to language and cognitive-control networks in bilingual adults can result in *pathological language mixing* (PLM)—the unintentional switching between languages due to impaired inhibitory control (Abutalabi et al., 2000; Abutalabi & Green, 2007). *Recursive self-feedback* (RSF) is a patient-driven approach that enhances language control by utilizing patients' own perceptual and metacognitive resources during goal-directed tasks (Imaezue et al., 2023). RSF is a self-directed technique in which individuals repeatedly produce, listen to, evaluate, and refine their own speech to improve language control and performance without external feedback (Imaezue et al., 2023, 2024).

RSF has been shown to improve sentence production and spontaneous speech in individuals with chronic nonfluent aphasia (e.g., Imaezue, 2024, Imaezue et al., 2024). This study examined whether RSF can improve target language production in a bilingual adult with chronic severe Broca's aphasia and PLM, specifically by increasing English verbal output during elicited spontaneous speech.

Methods

We studied Patient P3, a 59-year-old right-handed woman and premorbid Spanish and English-speaking bilingual who acquired severe Broca's aphasia in both languages and PLM after a left middle cerebral artery aneurysm with subarachnoid hemorrhage in 2019. Clinical assessments, including the English and Spanish versions of the Western Aphasia Battery-Revised (WAB-R: Kertesz, 2007) and Bilingual Aphasia Switching Questionnaire (Rodriguez-Fornells et al., 2012), confirmed her diagnosis. Her primary goal was to reduce unintentional Spanish intrusions and increase English usage.

Baseline elicited spontaneous speech responses to trained and untrained narrative prompts were collected at Timepoints 1 (T1) and 2 (T2), one week apart. Pre- and posttreatment assessments included English version of the WAB-R and task-specific spontaneous speech metrics (e.g., proportion of English words, correct information units, open-/closed-class words counts). Posttreatment speech responses to the trained and

untrained narrative prompts were collected at T3 (within a week posttreatment), and the English WAB-R was repeated at T4 (two weeks posttreatment).

P3 received RSF treatment at home via a custom mobile app. Each session involved listening to a narrative prompt, recording a 1-minute spontaneous speech response, listening to the playback, identifying errors (e.g., unintended language mixing), and reattempting the task. This cycle was repeated five times per prompt. P3 practiced for ~2 hours/day, 5 days/week, over three weeks (~28 hours total), using 10 narrative prompts adapted from a set of 30 (Imaezue, 2024). The app logged all sessions, and researchers monitored adherence remotely with biweekly check-ins. No other speech therapy was provided during the study.

Results

P3 demonstrated improvement across all spontaneous speech metrics, including both trained and untrained prompts (**Figure 1**, panels A–H). Additionally, she showed an 11-point increase in her English WAB-R Aphasia Quotient two weeks after completing the treatment (**Table 1**).

Conclusions

These findings indicate that bilingual individuals with Broca's aphasia and PLM can reduce unintentional language mixing and enhance target language control using RSF without external feedback. By activating cognitive effort and restoring agency, RSF presents a promising, scalable, and self-directed intervention for bilingual aphasia. Further research is warranted to confirm these results and investigate broader clinical applications.

References

- Abutalebi, J., & Green, D. (2007). Bilingual language production: The neurocognition of language representation and control. *Journal of Neurolinguistics*, 20(3), 242-275. <https://doi.org/10.1016/j.jneuroling.2006.10.003>
- Abutalebi, J., Miozzo, A., & Cappa, S. F. (2000). Do subcortical structures control language selection in bilinguals? Evidence from pathological language mixing. *Neurocase*, 6, 101-106. <https://doi.org/10.1080/13554790008402757>
- Helm-Estabrooks, N. (2017). *Cognitive-Linguistic Quick Test Plus*. The Psychological Corporation.
- Imaezue, G. C. (2024). Recursive self-feedback improves spontaneous speech in chronic aphasia within real-world settings. *Aphasiology*. Advance online publication. <https://doi.org/10.1080/02687038.2024.2432024>
- Imaezue, G. C., & Goral, M. (2024). Toward self-regulated learning in aphasia rehabilitation: A proposed framework. *Aphasiology*, 38(10), 1668-1683. <https://doi.org/10.1080/02687038.2024.2323219>
- Imaezue, G. C., Tchernichovski, O., & Goral, M. (2024). Self-improved language production in nonfluent aphasia through automated recursive self-feedback. *American Journal of Speech-Language Pathology*, 33(6S), 3343-3357. https://doi.org/10.1044/2024_AJSLP-23-00320

Imaezue, G. C., Tchernichovski, O., & Goral, M. (2023). Recursive self-feedback improved speech fluency in two patients with chronic nonfluent aphasia. *Aphasiology*, 38(5), 838-861. <https://doi.org/10.1080/02687038.2023.2239511>

Kertesz, A. (2007). *Western Aphasia Battery—Revised*. Pearson.

Rodriguez-Fornells, A., Krämer, U. M., Lorenzo-Seva, U., Festman, J., & Münte, T. F. (2012). Self-assessment of individual differences in language switching. *Frontiers in Psychology*, 2, 388. <https://doi.org/10.3389/fpsyg.2011.00388>

Acknowledgments

We appreciate the patient and her spouse for their consistent cooperation throughout the study. We also thank Ms. Clarissa Salas and Ms. Gianna Mineo for conducting weekly check-ins with the patient, assisting with data scoring and speech transcription. We are grateful to Dr. W. Scott Burgin for referring the patient to us.

This research was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development under Award P2CHD101899—Center for Smart Use of Technology to Assess Real-world Outcomes (C-STAR), with GCI as Subproject PI.

Figure 1. Summary and effect sizes of task-specific outcomes for trained and untrained prompts. Panels A–D show the mean percent of total English words, English CIUs, English open class words and English closed words, respectively. Errors bars represent standard deviation. Panels E–H show the same measures for untreated prompts. *Note.* CIUs = correct information units. Single asterisk (*) = small treatment-induced effect. Double asterisks (**) = moderate treatment-induced effect. Triple asterisks (***) = strong treatment-induced effect. The effect size is a metric for posttreatment performance relative to baseline 1 alone.

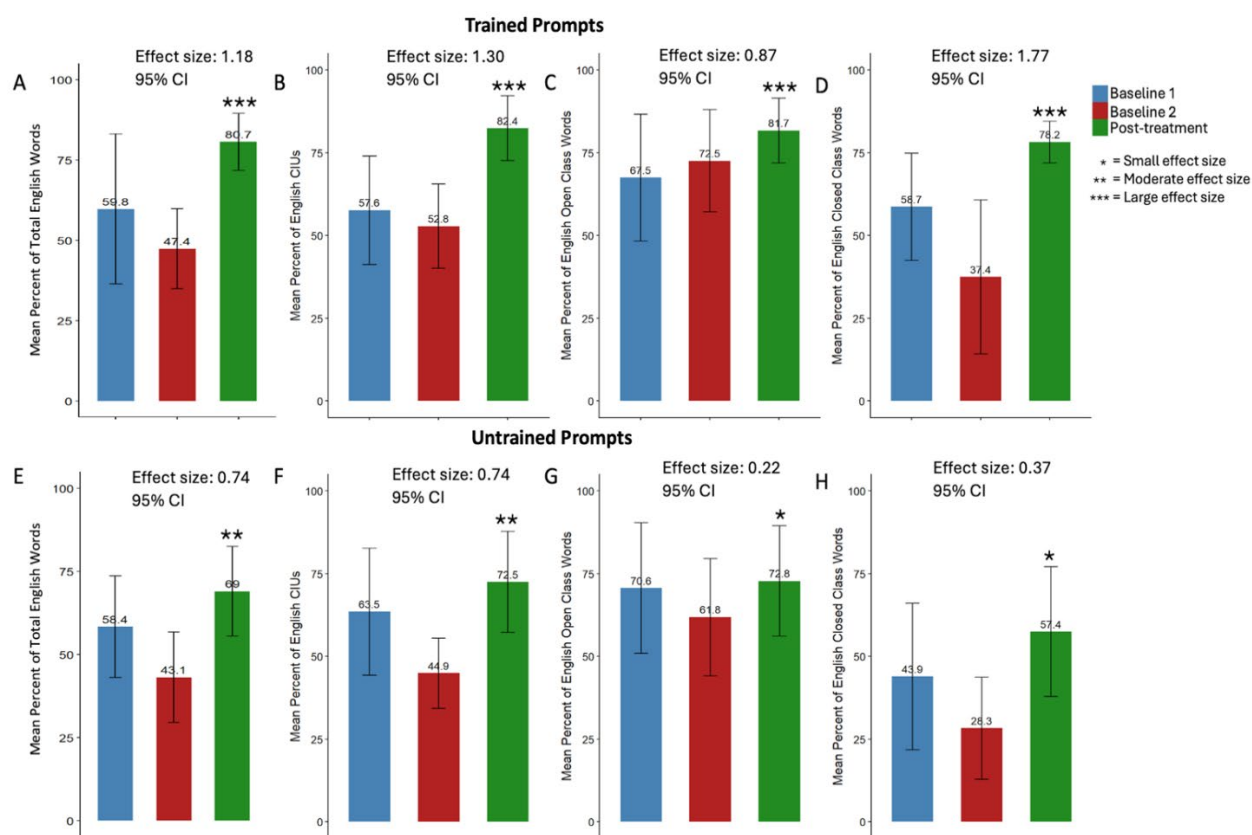


Table 1. Participant Responses on the Western Aphasia Battery-Revised (WAB-R) Subtests and Cognitive Linguistic Quick Test Plus (CLQT+) during Pre- and Post-Treatment Assessments.

WAB-R and CLQT+ Subscales	Baseline Score/Max Score	Post-treatment Score/Max Score
English Version: WAB-R		
Fluency and Grammar	2/10	4/10
Spontaneous Speech	2/10	5/10
Auditory comprehension	5/10	5/10
Repetition	1.8/10	2/10
Naming	4.5/10	5.7/10
Aphasia Quotient	32.3/100	43.2/100
Spanish Version: WAB-R		
Fluency and grammar	3/10	N/A
Spontaneous speech	2/10	N/A
Auditory comprehension	5.85/10	N/A
Repetition	1.8/10	N/A
Naming	4.5/10	N/A
Aphasia Quotient	33.7/100	N/A
English Version: CLQT+		
Attention	194/215	N/A
Memory	72/185	N/A
Executive Function	31/40	N/A
Language	14.5/37	N/A
Visuospatial skills	98/105	N/A
Clock drawing	11/13	N/A
Composite Severity Range	2.8/4.0	N/A

Note. WAB-R = Western Aphasia Battery-Revised; CLQT+ = Cognitive Linguistic Quick Test Plus; N/A = Not administered. No post-treatment measures were conducted for Spanish Western Aphasia Battery given that English was the target language.

Effects of age and noun–verb co-occurrence strength on action picture naming accuracy: A cross-sectional study of typically developing native Japanese children and healthy adults

Yuki Ishii^{1*}, Akira Uno², Jun Tanemura³

¹ Department of Rehabilitation, Kyorin University, Mitaka, Tokyo, Japan

² LD • Dyslexia center, Ichikawa, Chiba, Japan

³ Department of Rehabilitation, Biwako Professional University of Rehabilitation, Higashiomi, Shiga, Japan

*corresponding author, yuki-ishii@ks.kyorin-u.ac.jp

Introduction

It has been reported that high-frequency multi-word expressions (e.g., “don’t have to worry”) are processed more accurately and rapidly than low-frequency ones in healthy adults (Arnon & Snider, 2010; Arnon & Cohen Priva, 2013). Furthermore, Maouene et al. (2011) reported that semantic co-occurrence between nouns and verbs (e.g., “push” and “button”) plays a critical role in typically developing children’s verb acquisition. From these findings, we hypothesize that age and noun–verb co-occurrence strength (including particles) influence verb production. Verb-related tasks are widely used to assess aphasia and developmental language disorders, but the co-occurrence strength is rarely considered in test construction. This study examines how the co-occurrence strength of noun–verb phrases impacts action picture naming accuracy from healthy school-aged children to older adults, taking a cross-sectional perspective.

Methods

A total of 369 healthy native Japanese speakers aged 7–80 years participated in this study. A 24-item action naming task was administered to participants. The co-occurrence strength between nouns and verb phrases was determined using logDice from the Tsukuba Web Corpus. A generalized additive mixed model (GAMM) was fitted, with naming accuracy as the dependent variable, age as a smooth term, and co-occurrence (high vs. low) as a fixed effect; the participant was included as a random effect. Models with and without interaction terms were compared, and the interaction model was selected using on the Akaike Information Criterion. The analyses were conducted in R (version 4.4.3) using the mgcv package.

Results

GAMM analysis revealed a significant main effect of co-occurrence (estimate = -0.76 , $z = -2.79$, $p = .005$), with a lower accuracy in the low co-occurrence condition (L-CO) than in the high co-occurrence condition (H-CO). Age-related smooth effects were significant in both conditions, with naming accuracy showing different patterns across age. In H-CO, the predicted accuracy increased rapidly during school age, peaked in adulthood, and declined gradually in older age. By contrast, L-CO exhibited a slower increase through the school years and a marked decrease in older adulthood (Fig.1). Participant-level random effects were also significant (edf = 38.0, $p = .0016$). Moreover, in both school-

aged children and older adults, a greater variability in naming accuracy was observed in L-CO compared to H-CO (Fig. 2).

Conclusions

This study showed that action naming accuracy is affected by both the co-occurrence strength of noun–verb phrases and age. It was inferred that strong co-occurrence would automatically activate the noun–verb phrases as a robust semantic and phonological unitary representation from which the verb could be isolated to make retrieval more efficient. This result supported the theories of Maouene et al. (2011) and Bybee (2006). By contrast, verbs used in low-co-occurrence expressions were difficult for both school-aged children and older adults to recall, with individual differences observed. These findings suggest that assessments incorporating low-co-occurrence verbs may help detect developmental delays and functional declines in language. They also imply that training that incorporates graded co-occurrence strengths could have a greater impact on the rehabilitation of individuals with aphasia and developmental language disorders.

References

- Arnon, I., & Snider, N. (2010). More than words: Frequency effects for multi-word phrases. *Journal of memory and language*, 62(1), 67-82.
- Arnon, I., & Cohen Priva, U. (2013). More than words: The effect of multi-word frequency and constituency on phonetic duration. *Language and speech*, 56(3), 349-371.
- Maouene, J., Laakso, A., & Smith, L. B. (2011). Object associations of early-learned light and heavy English verbs. *First Language*, 31(1), 109-132.
- Bybee, J. L. (2006). From usage to grammar: The mind's response to repetition. *Language*, 82(4), 711-733.

Acknowledgments

This research was supported by JSPS KAKENHI Grant Number JP18H01092, JP23K16583. We thank the participants who devoted their effort and time for this project as well as the other colleagues who assisted us with data collection and analysis.

Figure 1. Predicted Accuracy in Action Naming by Age and Condition

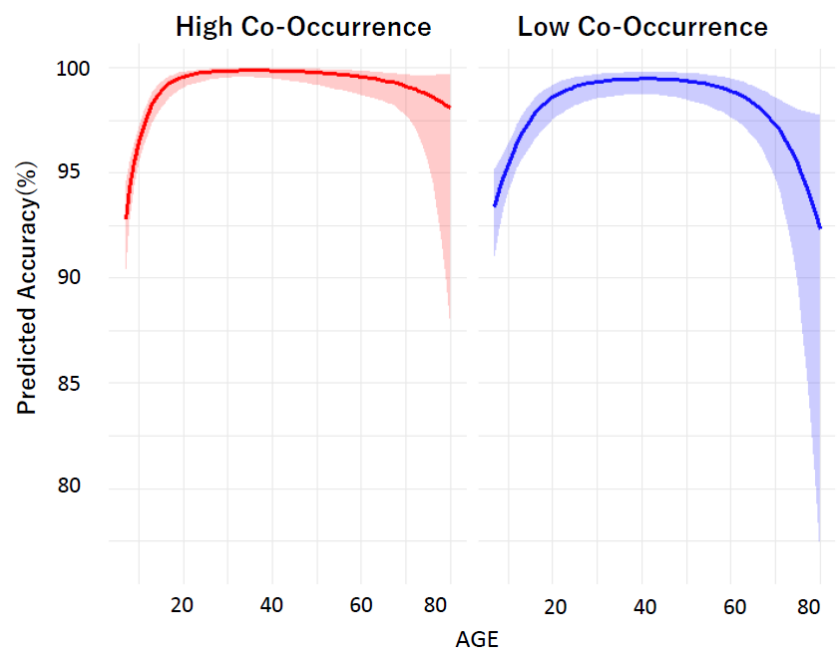
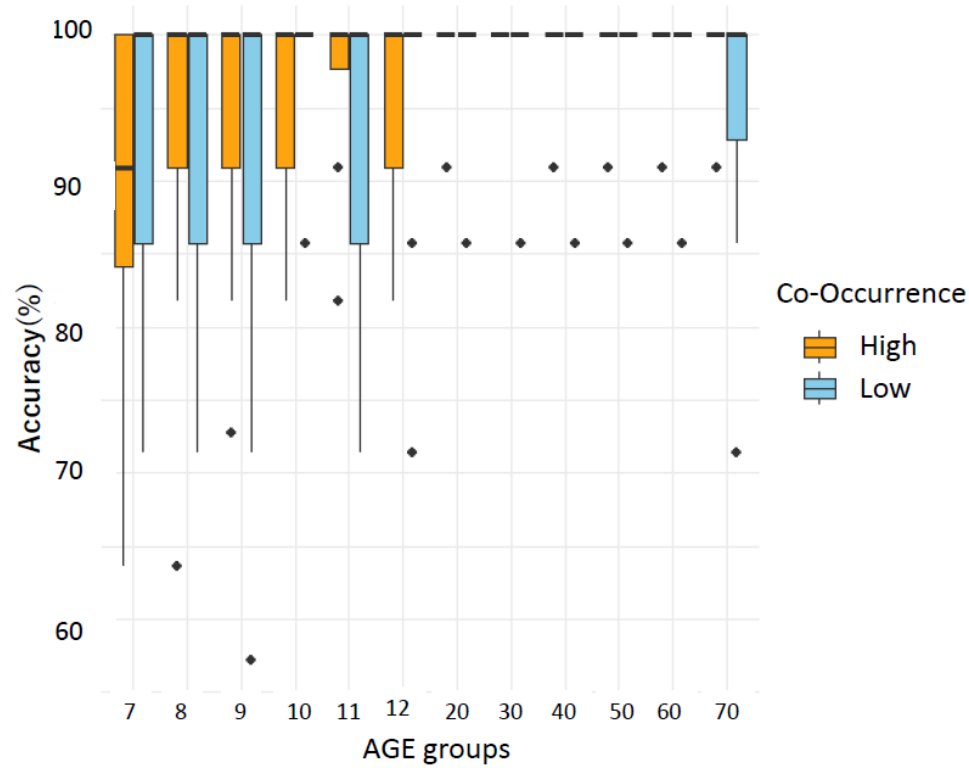


Figure 2. Action Naming Accuracy Across Age Groups by Condition



Balanced Tasks, Unbalanced Performance: Noun and Verb Processing in Post-Stroke Aphasia

Maria V. Ivanova^{1*}, Olga Soloukhina², Olga Buivolova², and Olga Dragoy^{2,3}

¹ Department of Psychology, University of California Berkeley, Berkeley, CA, USA

² HSE University, Moscow, Russia

³ Institute of Linguistics, Russian Academy of Sciences, Moscow, Russia

*corresponding author, ivanova@berkeley.edu

Introduction

Single-word processing impairments are common in aphasia, particularly in word production, with word-finding difficulties being the most prevalent deficit across aphasia types. Research documenting noun-verb dissociations began over two decades ago (Miceli et al., 1988), yet findings remain inconsistent and have had limited impact on theoretical models or clinical practice. While studies generally report greater difficulty with verb production (Mätzig et al., 2009; Thompson et al., 2012), results are more mixed for comprehension tasks (Alyahya et al., 2018; Soloukhina & Ivanova, 2018).

The aim of this study was to examine whether the noun-verb dissociation in aphasia is consistent across modalities. We directly compared noun and verb processing using fully balanced, parallel tasks for both comprehension and production in a large sample of Russian-speaking individuals with post-stroke aphasia.

Methods

We analyzed data from 156 individuals with chronic post-stroke aphasia who completed four tasks from the Russian Aphasia Test (Ivanova et al., 2021): noun comprehension, verb comprehension, object naming, and action naming. Tasks were carefully matched for key psycholinguistic variables of the target words including name agreement, visual complexity, concept familiarity, age of acquisition, imageability, image agreement, word frequency, and length in syllables, allowing for direct comparison of performance between tasks. Performance was evaluated based on accuracy and error patterns (for naming tasks) using a generalized linear mixed-effects model and t-tests.

Results

Participants performed significantly better on comprehension tasks than on production tasks (Figure 1). Crucially, across both modalities, nouns had higher accuracy than verbs (Figure 1). Error analysis revealed differing patterns: semantic paraphasias were more common in action naming, while phonological paraphasias predominated in object naming (Table 1).

Conclusions

Our findings indicate that word production is more difficult than comprehension for individuals with aphasia, highlighting the greater challenge of word retrieval compared to matching an auditory stimulus to its visual semantic representation. Further, our results revealed that verbs are more challenging than nouns across both production and

comprehension. Given the large sample included in this study and the fact that the tasks were carefully matched for all relevant psycholinguistic parameters, these results strongly support the existence of modality-general noun-verb dissociations. The greater difficulty associated with verbs may stem from their increased semantic and grammatical complexity (Cappa & Perani, 2003; Druks, 2002; Kim & Thompson, 2000), which is not easily captured by psycholinguistic parameters common to both word classes. The high rate of semantic errors in verb production further underscores their cognitive and linguistic complexity. These findings have important implications for theoretical models of single-word processing, which must account for differences in processing across word classes. Clinically, they emphasize the need to assess verb processing in addition to noun processing, as this may reveal further deficits. Moreover, incorporating verbs into therapy may promote broader improvements in word retrieval, potentially generalizing to simpler lexical items such as nouns.

References

- Alyahya, R. S. W., Halai, A. D., Conroy, P., & Lambon Ralph, M. A. (2018). Noun and verb processing in aphasia: Behavioural profiles and neural correlates. *Neuroimage Clinical*, 18, 215–230.
- Cappa, S., & Perani, D. (2003). The neural correlates of noun and verb processing. *Journal of Neurolinguistics*, 16, 183–189.
- Druks, J. (2002). Verbs and nouns – a review of the literature. *Journal of Neurolinguistics*, 15, 289–315.
- Ivanova, M. V., Akinina, Yu. S., Soloukhina, O. A., Iskra, E. V., Buivolova, O. V., Charbacz, A. V., Stupina, E. A., Khudyakova, M. V., Akhutina, T. V., & Dragoy, O. (2021). The Russian Aphasia Test: The first comprehensive, quantitative, standardized, and computerized aphasia language battery in Russian. *PLOS ONE*, 16(11), e0258946.
- Kim, M., & Thompson, C. (2000). Patterns of comprehension and production of nouns and verbs in agrammatism: Implications for lexical organization. *Brain and Language*, 74, 1–25.
- Mätzig, S., Druks, J., Masterson, J., & Vigliocco, G. (2009). Noun and verb differences in picture naming: Past studies and new evidence. *Cortex*, 45, 738–758.
- Miceli, G., Silveri, M. C., Nocentini, U., & Caramazza, A. (1988). Patterns of dissociation in comprehension and production of nouns and verbs. *Aphasiology*, 2, 351–358.
- Soloukhina, O., & Ivanova, M.V. (2018). Investigating comprehension of nouns and verbs: Is there a difference? *Aphasiology*, 32(2), 183–203.
- Thompson, C. K., Lukic, S., King, M. C., Mesulam, M. M., & Weintraub, S. (2012). Verb and noun deficits in stroke-induced and primary progressive aphasia: The Northwestern Naming Battery. *Aphasiology*, 26, 632–655.

Acknowledgments

We are grateful to Roman Cheremin for providing access to the resources of the Center for Speech Pathology and Neurorehabilitation, Moscow, Russia. We also thank Ekaterina Iskra, Svetlana Averina, Svetlana Malyutina, research assistants and volunteers of the Center for Language and Brain for their assistance with data collection. This work was funded as part of the Basic Research Program at the HSE University and a research

project grant No. 1403-18/23. MVI contribution was supported by the NIDCD R01DC022663.

Figure 1. Accuracy rates for noun and verb processing across production and comprehension tasks. The bars represent the percentage of correct responses for each word class and modality. Significance was established with a generalized linear mixed-effects model.

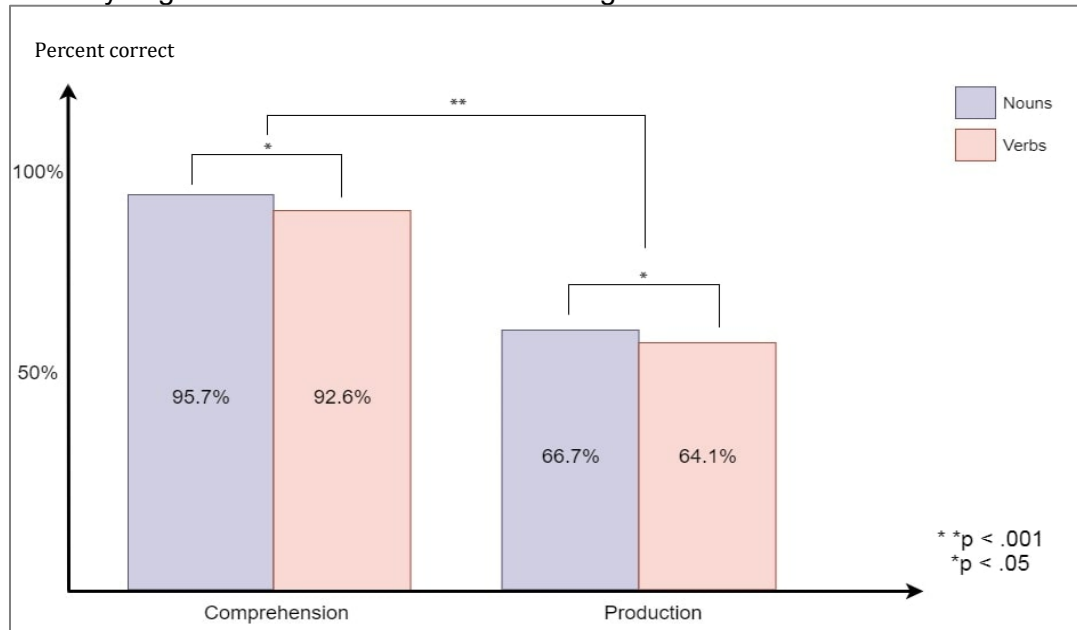


Table 1. Percentage of semantic and phonological paraphasias in object and action naming tasks among participants with aphasia. Error types were compared using t-tests.

Task	Semantic paraphasias <i>M (SD)</i> <i>range</i>	Phonological paraphasias <i>M (SD)</i> <i>range</i>	T-test
Object naming	4.9% (21.5) 0 – 9%	8.0% (27.2) 0 – 18%	$t = 5.55, p < .001$
Action naming	8.7% (28.1) 0 – 10%	5.4% (22.6) 0 – 14%	$t = -5.49, p < .001$
T-test	$t = -6.52, p < .001$	$t = 4.51, p < .001$	

Brain and Language: An Analysis of Language Processing in Aphasia Among Adults in Select Tier Four Hospitals, Nakuru County, Kenya

Mercyrose Jesang*

Department of Linguistics, Maasi Mara University

***Corresponding Author, mercynashy@gmail.com**

Introduction

Aphasia is a neurological condition that typically results from left-hemisphere brain damage, leading to deficits in speech production, language comprehension, and other linguistic functions (Kertesz, 2007). In Kenya, limited research exists on the correlation between lesion location and linguistic impairments in aphasic patients. This study aimed to fill this gap by analyzing language processing among adults with aphasia in Tier Four hospitals in Nakuru County. The study was anchored in Broca's and Wernicke's theoretical frameworks of language localization and the Communication Accommodation Theory (Giles, Coupland, & Coupland, 1991), which emphasizes adaptive communication strategies.

Methods

A correlational case study design within a mixed-methods framework was adopted. A total of 36 respondents were selected from a target population of 116 through purposive and convenience sampling, based on Kothari's formula (Kothari, 2004). Data collection tools included observation schedules, semi-structured interviews, document analysis, and closed-ended questionnaires administered to speech-language therapists and neurologists. Quantitative data were analyzed using descriptive statistics (mean, frequency, standard deviation) and chi-square tests to identify relationships between lesion locations and language deficits. Thematic analysis was applied to qualitative data to extract emergent themes regarding individual language impairments.

Results

The study found statistically significant associations between the location of brain lesions and the severity of aphasia symptoms ($\chi^2 = 18.24$, $p < 0.05$). Lesions in the Broca's area correlated with expressive language deficits, while Wernicke's area lesions corresponded with receptive language impairments. Variability in speech production was observed among individuals with similar lesion locations, suggesting that cognitive reserve and premorbid language ability influenced aphasia severity.

Thematic analysis identified three recurring challenges: syntactic disruptions, semantic retrieval issues, and reduced fluency. Clinical observations further highlighted that early intervention and structured rehabilitation improved language outcomes.

Conclusions

This study affirms that lesion location is a significant predictor of specific language deficits in aphasia. Findings support existing psycholinguistic theories and offer valuable input for clinical diagnosis and rehabilitation strategies in Kenya's healthcare context. The results

also emphasize the need for tailored speech therapy programs and assistive communication technologies to address individual variability in aphasia symptoms.

References

- Giles, H., Coupland, N., & Coupland, J. (1991). *Contexts of accommodation: Developments in applied sociolinguistics*. Cambridge University Press.
- Kertesz, A. (2007). *Western Aphasia Battery – Revised (WAB-R)*. Pearson.
- Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International Publishers.

Acknowledgments

The author wishes to thank the medical and speech therapy teams at Nakuru Level Five Hospital and the Rift Valley Provincial General Hospital for their invaluable support in data collection. Special appreciation goes to the study participants and their caregivers for their time and openness. This research was supported by Maasai Mara University's Department of Linguistics.

Table 1. Relationship between Lesion Location and Type of Language Deficit

Lesion Location	Primary Deficit	Frequency (n=36)	Percentage (%)
Broca's Area	Expressive Aphasia	14	38.9
Wernicke's Area	Receptive Aphasia	11	30.6
Global	Mixed Language Deficits	7	19.4
Other	Mild Comprehension Deficits	4	11.1

The Impact of Communication Events on Communicative Stress in People with Aphasia: An Ecological Momentary Assessment Study

Courtney C. Jewell^{*1}, Jessica Krok-Schoen², and Stacy M. Harnish¹

¹Department of Speech and Hearing Science, The Ohio State University, Columbus, Ohio, USA

²School of Health and Rehabilitation, The Ohio State University, Columbus, Ohio, USA

***corresponding author, jewell.196@osu.edu**

Introduction: People with aphasia (PWA) experience higher levels of stress in comparison to adults without aphasia (Hunting Pompon et al., 2018), however, the sources of overall stress experienced by PWA are understudied. Current approaches to measuring stress are limited in that the assessment tools are retrospective and rely on individuals to recall events from the past (Zini & Banfi, 2021). Ecological momentary assessments (EMAs) allow for the collection of data in the real world, which reduces the impact of recall bias and allows for the “in-the-moment” collection of data with real-world applicability (Shiffman et al., 2008). EMAs may be particularly useful for aphasia research, as they enable PWA to document their mood and communication experiences in real time. This real-time data collection can subsequently guide personalized interventions (Bui et al., 2022). For the first time, this research utilizes EMAs to: a) identify real-world communication events most frequently identified as highly stressful, and b) examine how specific types of communication events, along with broader individual-level factors, contribute to real-time communicative stress.

Methods: Twenty-five PWA with chronic aphasia (> 6 months) were sent text messages to answer five prompts one time a day for ten consecutive days (i.e., 10 total surveys). See Table 1 for Participant Demographics. Participants were asked to rate their general stress, stressful communication events, and perceived stress during the communication event. Data was analyzed using descriptives and linear mixed-effects models, which handle missing data that can be innate to EMA protocols by appropriately modeling the variance in incomplete data.

Results

Aim 1: PWA identified a wide range of communication events as stressful in real-time (See Figure 1). Communication events that required sharing detailed information were the most frequent event (n = 52) identified as stressful, followed by communicating with people they did not know (n = 28) and within small groups (n = 25). Descriptively, there was variability in events reported between and within participants.

Aim 2: The event type “other” (e.g., participants were able to type their specific communication event) was significantly associated with lower communicative stress (Estimate = -1.14286, p = 0.005). The communication event of “fast-moving conversations” was marginally associated with higher levels of communicative stress (Estimate = 0.69048, p = 0.05367). Other event types did not show significant associations with communicative stress. Depression (Estimate = 0.01709, p = 0.19366) and severity of

aphasia (Estimate = -0.04095, $p = 0.19626$) were not significant predictors of communicative stress.

Conclusions: With a larger sample size, certain communication events, such as fast-moving conversations, may predict perceived stress. Nonetheless, individual variability is hypothesized to play a significant role in communicative events that are deemed stressful. Understanding individual variability in communicative stress and real-world events that influence stress can improve personalized treatment plans. Lastly, EMAs have shown to be a powerful tool for detecting this variability and are a promising approach for future research.

References

- Bui, Q., Kaufman, K. J., Pham, V., Lenze, E. J., Lee, J.-M., Mohr, D. C., Fong, M. W. M., Metts, C. L., Tomazin, S. E., & Wong, A. W. K. (2022). Ecological Momentary Assessment of Real-World Functional Behaviors in Individuals With Stroke: A Longitudinal Observational Study. *Archives of Physical Medicine and Rehabilitation*, 103(7), 1327–1337. <https://doi.org/10.1016/j.apmr.2022.02.011>
- Hunting Pompon, R., Amtmann, D., Bombardier, C., & Kendall, D. (2018). Modifying and Validating a Measure of Chronic Stress for People With Aphasia. *Journal of Speech, Language, and Hearing Research: JSLHR*, 61(12), 2934–2949. https://doi.org/10.1044/2018_JSLHR-L-18-0173
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, 4, 1–32. <https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>
- Zini, M. L. L., & Banfi, G. (2021). A Narrative Literature Review of Bias in Collecting Patient Reported Outcomes Measures (PROMs). *International Journal of Environmental Research and Public Health*, 18(23), 12445. <https://doi.org/10.3390/ijerph182312445>

Acknowledgments

This study was supported by research grants from the National Institutes of Health / National Institute on Deafness and Other Communication Disorders [grant numbers F31DC022142 (Trainee: Jewell); R01DC017711 (PI: Harnish)] and National Institute on Aging [grant number 1R21AG078258-01A1 (PI: Krok-Schoen)]. The content is solely the responsibility of the authors and does not necessarily represent the official view of the National Institutes of Health.

Figure 1. Variability of Communication Events by Participant.

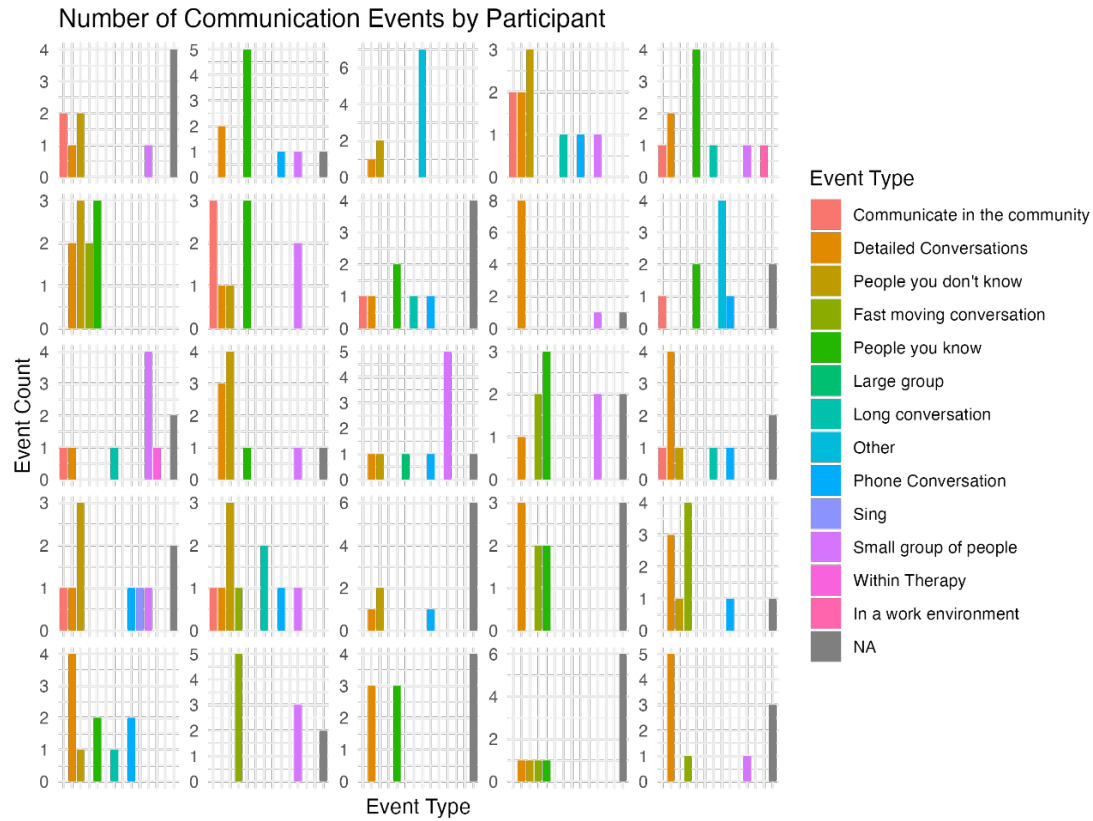


Table 1. Participant Demographics

Age	60.58 (12.46)
Gender	13 F (52%) 12 M (48%)
Race	22 White (88%) 2 Asian (8%) 1 Black (4%)
Month Post Stroke	104.72 (163.69)
Education^a	15.83 (0.56)
QAB Severity	
Mild	9 (36%)
Moderate	9 (36%)
Severe	1 (.03%)
NAPQ ^b	6 (25%)

In which cases are prepositions difficult to judge? Disentangling impairments in word order and functional elements in agrammatic aphasia

Yuval Z. Katz* and Naama Friedmann

Language and Brain Lab, Tel Aviv University, Tel Aviv, Israel

***corresponding author, yuvalzkatz@gmail.com**

Introduction

The term “agrammatism” implies that individuals with this condition struggle with grammar, but what exactly in grammar is impaired? Aphasiological research often conflates two distinct deficits: difficulty with functional elements and difficulty with word order, particularly in non-canonical sentences. While prepositions are considered prototypical functional elements, studies have reported inconsistent findings regarding their impairment in agrammatism. It remains unclear whether prepositions are impaired, and whether selected prepositions, often considered more functional, are more affected than unselected prepositions (Friederici, 1982; Grodzinsky, 1988; Linebarger et al., 1983).

This study investigates whether agrammatism necessarily involves both a deficit in functional elements and in syntactic movement. We examine whether individuals with agrammatism show difficulty judging the grammaticality of prepositions when prepositions appear in their original, post-verbal position (in situ), and when the prepositional phrase is moved to the CP (in questions, topicalization, and relative clauses). We also contrast selected and unselected prepositions.

Methods

Participants were 10 Hebrew-speaking individuals with agrammatic aphasia (five with post-stroke aphasia and five with Primary Progressive Aphasia), and 10 non-impaired controls. Syntactic impairment was confirmed using independent comprehension and production tasks. All participants completed a grammaticality judgment task involving 48 sentences (half grammatical, half ungrammatical with incorrect preposition), manipulating two variables: whether the prepositional phrase was in situ or moved, and whether the preposition was selected or unselected by the verb. Participants could reread sentences or ask the experimenter to read them aloud, minimizing memory demands.

Results

Control participants performed at ceiling across all conditions. Individuals with agrammatism performed well on ungrammatical sentences with in-situ prepositions ($M = 94\%$), but showed significantly reduced accuracy when the prepositional phrase was moved ($M = 67\%$; $t(9) = 5.79$, $p < .001$). Accuracy on grammatical sentences was high both without movement ($M = 98\%$) and with movement ($M = 93\%$), with a marginally significant difference ($t(9) = 2.27$, $p = .049$). No significant difference was found between selected and unselected prepositions in the detection of ungrammatical moved sentences ($t = 0.39$, $p = .7$).

Conclusions

Our findings challenge the view that agrammatism entails a general impairment in functional elements. Participants detected ungrammaticality when the preposition remained in situ, but failed to do so when it was moved. This suggests that the difficulty lies not in accessing prepositions themselves but in constructing syntactic dependencies involving the CP, as predicted under the Tree Pruning Hypothesis (Friedmann, 2002, 2006; Friedmann & Grodzinsky, 1997). Selected and unselected prepositions require licensing within the verb phrase. When displaced to the CP, individuals with agrammatism cannot establish a link between the preposition and the verb, which prevents them from evaluating their congruence (Figure 1). These results support a fine-grained model of grammatical impairments in aphasia, sensitive to syntactic configuration. Difficulties with in situ prepositions, as reported in previous studies, may stem from additional deficits, such as impaired access to lexical-syntactic representations (Biran & Friedmann, 2012) or phonological output buffer impairments affecting production (Dotan & Friedmann, 2015).

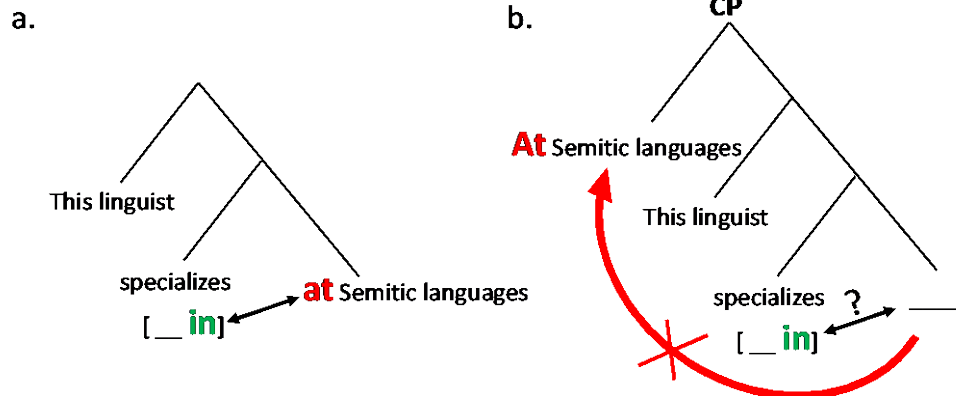
References

- Biran, M., & Friedmann, N. (2012). The representation of lexical-syntactic information: Evidence from syntactic and lexical retrieval impairments in aphasia. *Cortex*, 48(9), 1103–1127.
- Dotan, D., & Friedmann, N. (2015). Steps towards understanding the phonological output buffer and its role in the production of numbers, morphemes, and function words. *Cortex*, 63, 317–351. <https://doi.org/10.1016/j.cortex.2014.08.014>
- Friederici, A. D. (1982). Syntactic and semantic processes in aphasic deficits: The availability of prepositions. *Brain and Language*, 15(2), 249–258. [https://doi.org/10.1016/0093-934X\(82\)90059-1](https://doi.org/10.1016/0093-934X(82)90059-1)
- Friedmann, N. (2002). Syntactic tree pruning and question production in agrammatism. *Brain and Language*, 83(1), 117–120.
- Friedmann, N. (2006). Speech Production in Broca's Agrammatic Aphasia: Syntactic Tree Pruning. In Y. Grodzinsky & K. Amunts (Eds.), *Broca's Region* (pp. 63–82). Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780195177640.003.0005>
- Friedmann, N., & Grodzinsky, Y. (1997). Tense and Agreement in Agrammatic Production: Pruning the Syntactic Tree. *Brain and Language*, 56(3), 397–425. <https://doi.org/10.1006/brln.1997.1795>
- Grodzinsky, Y. (1988). Syntactic representations in agrammatic aphasia: The case of prepositions. *Language and Speech*, 31(2), 115–134.
- Linebarger, M. C., Schwartz, M. F., & Saffran, E. M. (1983). Sensitivity to grammatical structure in so-called agrammatic aphasics. *Cognition*, 13(3), 361–392. [https://doi.org/10.1016/0010-0277\(83\)90015-X](https://doi.org/10.1016/0010-0277(83)90015-X)

Acknowledgments

We thank the participants in the study.

Figure 1. Detection of incorrect prepositions in situ and moved, in agrammatic aphasia



In (a) the prepositional phrase follows the verb and is therefore available in agrammatism. Individuals with agrammatism can compare the preposition *at* used in the sentence to the preposition *in* listed in the lexical entry of *specialize*, and therefore they can identify that the sentence is ungrammatical. In (b), on the other hand, the prepositional phrase moves to the CP layer. Patients with agrammatism cannot establish a chain between the prepositional phrase and its original position following the verb, and therefore they do not know that the preposition used in the sentence is not the one listed in the lexical entry of the verb.

Development and Validation of the Animated Sentence Production Test for Aphasia

Zeinab Khoshhal Mollasaraei ^{1*}, Gregory Hickok ², Dirk B. den Ouden ¹, Julius Fridriksson ¹, William Matchin ¹

¹ Department of Communication Sciences and Disorders, University of South Carolina

² Department of Cognitive Sciences, Department of Language Sciences, University of California, Irvine

*corresponding author, Zeinabk@email.sc.edu

Introduction

Sentence production deficits are a major challenge in aphasia (Caramazza & Zurif, 1976; Linebarger et al., 2000; Mitchum & Berndt, 2008; Rochon et al., 2000; Saffran et al., 1989). Since communication occurs primarily through sentences, sentence-level treatment is crucial and requires appropriate assessment. Current assessment methods have limitations. Spontaneous speech tasks, like story retelling, allow avoidance of complex structures (Weintraub et al., 2009; Wilshire et al., 2014) and obscure the causes of error (Webster et al., 2004). Constrained tasks, such as single-picture descriptions, rely on metalinguistic prompts, adding cognitive demands that obscure true errors (Bastiaanse et al., 2003; Cho-Reyes & Thompson, 2012; Weintraub et al., 2009; Wilshire et al., 2014).

The Animated Sentence Production Test addresses these issues through a structured format that targets specific sentence construction skills, minimizes extralinguistic cues, is easy to score, and uses animations to enhance ecological validity in action naming.

Methods

Fifteen individuals participated (Table 1). Object stimuli ($n = 23$) came from SCANT (Walker et al., 2022); verbs were selected from HANA (Breining et al., 2022). Animated actions replaced static images. Sentence production included 10 active and 10 passive items. Tasks followed this order: object naming, action naming, and sentence production. Failed items were probed for repetition and comprehension. Responses were recorded and scored for accuracy. Validity was assessed through correlations with WAB-R (Kertesz, 2007) and NAVS (Cho-Reyes & Thompson, 2012). Reliability was measured with Cronbach's alpha, and task differences were analyzed using Friedman's test.

Results

1.1. Validity

Strong correlations emerged between object naming and WAB-R naming ($p=0.88$, $p<.001$), NAVS SPPT active and active sentence production ($p=0.78$, $p=0.021$), and NAVS SCT active and active sentence comprehension ($p=0.81$, $p=0.014$). A moderate correlation was found between object and WAB-R comprehension ($p=0.54$, $p=0.038$). Non-significant correlations included NAVS VCT and action comprehension ($p=0.31$, $p=0.462$) and SPPT passive with passive production ($p=0.35$, $p=0.389$). Pearson's r showed strong links for repetition and WAB-R repetition ($r=0.92$, $p<.001$) and between

NAVS VNT and action naming ($r=0.88$, $p=0.004$). Passive sentence comprehension showed a weak, non-significant correlation with NAVS SCT passive ($r=0.15$, $p=0.723$).

1.1. Reliability

The reliability analysis showed excellent internal consistency for object naming ($\alpha = 0.967$, 23 items). Action naming ($\alpha = 0.883$, 11 items) and active sentence production ($\alpha = 0.836$, 11 items) demonstrated strong and good consistency, respectively. Passive sentence production ($\alpha = 0.751$, 11 items) exhibited acceptable reliability.

1.2. Performance Across Tasks

Friedman's test showed significant performance differences across tasks ($\chi^2 = 133.42$, $df = 11$, $p < .001$). Wilcoxon tests with Bonferroni correction revealed key contrasts: action naming vs. comprehension ($p = 0.001$), object repetition vs. comprehension ($p = 0.005$), and both active and passive sentence production vs. object comprehension ($p < .001$). No significant differences were found between active sentence repetition and comprehension ($p = 0.803$) or between active and passive sentence repetition ($p = 1.000$) (Figure 1).

Conclusions

The test showed excellent validity with the WAB-R, though correlations with the NAVS were weaker, likely due to NAVS's higher task demands. It also demonstrated excellent reliability. Variability in task performance supports its utility in identifying different levels of impairment. Offering a broad view of sentence production skills, along with efficient administration and clear scoring, the test serves as a practical and effective tool for both clinical assessment and aphasia research.

Acknowledgments

This work was supported by internal funding from the University of South Carolina.

References

- Bastiaanse, R., Edwards, S., Maas, E., & Rispens, J. (2003). Assessing comprehension and production of verbs and sentences: The Verb and Sentence Test (VAST). *Aphasiology*, 17(1). <https://doi.org/10.1080/729254890>
- Breining, B. L., Faria, A. V., Caffo, B., Meier, E. L., Sheppard, S. M., Sebastian, R., Tippet, D. C., & Hillis, A. E. (2022). Neural regions underlying object and action naming: Complementary evidence from acute stroke and primary progressive aphasia. *Aphasiology*, 36(6), 732–760. <https://doi.org/10.1080/02687038.2021.1907291>
- Caramazza, A., & Zurif, E. B. (1976). Dissociation of algorithmic and heuristic processes in language comprehension: Evidence from aphasia. *Brain and Language*, 3(4). [https://doi.org/10.1016/0093-934X\(76\)90048-1](https://doi.org/10.1016/0093-934X(76)90048-1)
- Cho-Reyes, S., & Thompson, C. K. (2012). Verb and sentence production and comprehension in aphasia: Northwestern Assessment of Verbs and Sentences (NAVS). *Aphasiology*, 26(10). <https://doi.org/10.1080/02687038.2012.693584>
- Kertesz, A. (2007). *Western Aphasia Battery-Revised*. San Antonio, TX: The Psychological Corporation.

- Linebarger, M. C., Schwartz, M. F., Romania, J. R., Kohn, S. E., & Stephens, D. L. (2000). Grammatical Encoding in Aphasia: Evidence from a "Processing Prosthesis." *Brain and Language*, 75(3), 416–427. <https://doi.org/10.1006/brln.2000.2378>
- Mitchum, C., & Berndt, R. S. (2008). Comprehension and production of sentences. In B. Hallowell & R. Chapey (Eds.), *Language intervention strategies in aphasia and related communication disorders* (pp. 632–653).
- Rochon, E., Saffran, E. M., Berndt, R. S., & Schwartz, M. F. (2000). Quantitative analysis of aphasic sentence production: Further development and new data. *Brain and Language*, 72(3). <https://doi.org/10.1006/brln.1999.2285>
- Saffran, E. M., Berndt, R. S., & Schwartz, M. F. (1989). The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language*, 37(3), 440–479. [https://doi.org/10.1016/0093-934X\(89\)90030-8](https://doi.org/10.1016/0093-934X(89)90030-8)
- Walker, G. M., Fridriksson, J., Hillis, A. E., den Ouden, D. B., Bonilha, L., & Hickok, G. (2022). The Severity-Calibrated Aphasia Naming Test. *American Journal of Speech-Language Pathology*, 31(6), 2722–2740. https://doi.org/10.1044/2022_AJSLP-22-00071
- Webster, J., Franklin, S., & Howard, D. (2004). Investigating the sub-processes involved in the production of thematic structure: An analysis of four people with aphasia. *Aphasiology*, 18(1). <https://doi.org/10.1080/02687030344000481>
- Weintraub, S., Mesulam, M. M., Wieneke, C., Rademaker, A., Rogalski, E. J., & Thompson, C. K. (2009). The northwestern anagram test: Measuring sentence production in primary progressive aphasia. *American Journal of Alzheimer's Disease and Other Dementias*, 24(5). <https://doi.org/10.1177/1533317509343104>
- Wilshire, C. E., Lukken, C. C., & Burmester, B. R. (2014). The sentence production test for aphasia. *Aphasiology*, 28(6). <https://doi.org/10.1080/02687038.2014.893555>

Figure 1. This figure shows the mean percentage scores across tasks, with highest score for object Comprehension and lowest scores for passive sentence production.

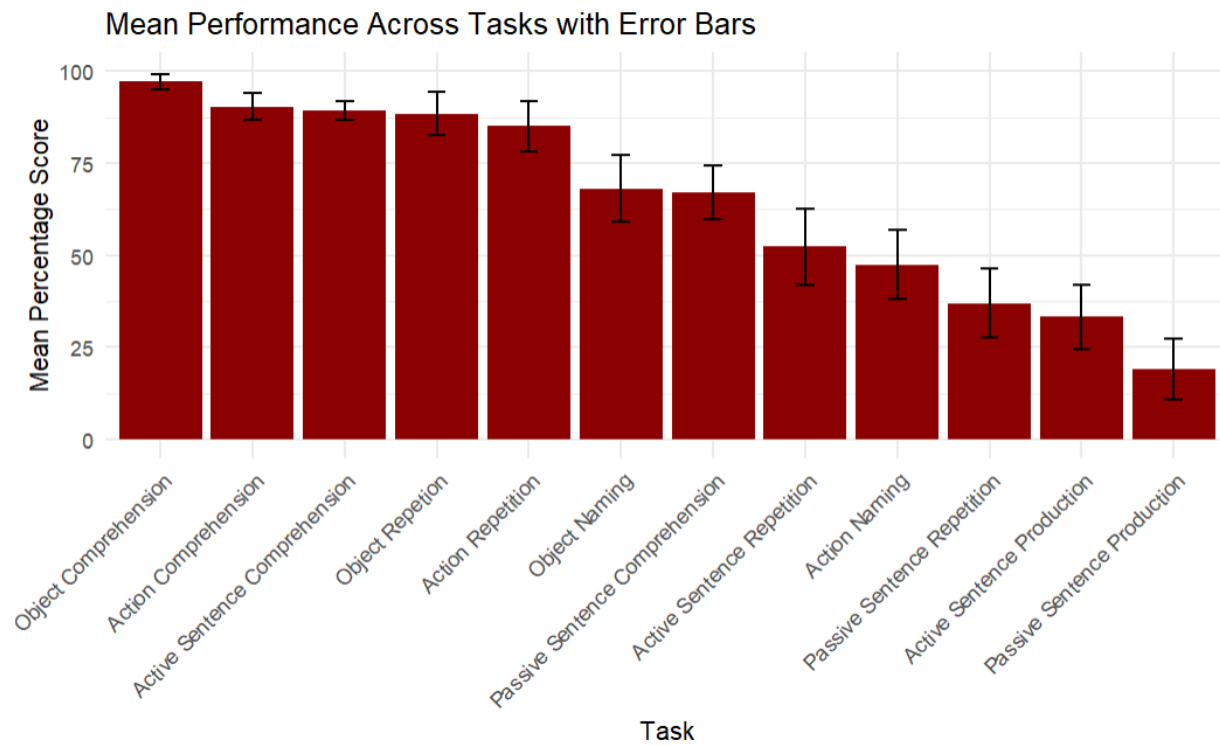


Table 1. Demographic Information of Subjects

Participant	Education	Dominant Hand	Days post-stroke	Age	Gender
1	Associate's degree	Right	4334	43	Female
2	High school/GED	Right	5432	60	Male
3	Master's degree	Right	2362	63	Male
4	Bachelor's degree	Right	2439	55	Male
5	Bachelor's degree	Left	NA	NA	Female
6	Bachelor's degree	Right	829	66	Male
7	High school/GED	Right	435	60	Male
8	Bachelor's degree	Right	502	43	Male
9	High school/GED	Right	388	50	Male
10	Bachelor's degree	Left	904	NA	Male
11	Doctoral or other advanced degree	Right	NA	NA	Male
12	High school/GED	Right	NA	NA	Male
13	Bachelor's degree	Right	NA	NA	Female
14	High school/GED	Right	NA	NA	Male
15	Unknown	NA	NA	NA	Male

The Development of Stimuli for Bilingual Abstract Semantic Associative Network Training (BAbSANT) for Persian Persons with Aphasia

Faranak Kianfar*, Chaleece W. Sandberg

Communication Sciences and Disorders, Penn State University, State College, PA,
USA

***Corresponding author, fqk5135@psu.edu**

Introduction

Aphasia, often marked by anomia, affects communication, especially when abstract words are impaired, as abstract words make up the bulk of our vocabulary (Lupyan & Winter, 2018). While most anomia therapy focuses on concrete words, AbSANT, a semantic-based approach, focuses on abstract word retrieval and shows generalization to concrete words (Sandberg et al., 2023; Kiran, Sandberg, & Abbott, 2009). Its bilingual version, BAbSANT, has been adapted into several languages, showing cultural flexibility (e.g., Sandberg et al., 2021). While SFA and PCA have been used in Persian (Asadi et al., 2014; Sadeghi et al., 2017), no treatment yet targets abstract words. This research aimed to provide culturally and linguistically relevant stimuli for the extension of BAbSANT to Persian people with aphasia (PWA).

Methods

Ten native Persian-speaking adults (ages 24–46; 4 males, 6 females) with no history of neurological or language disorders have participated in the study to date. Ten thematic categories were selected from previous work in the lab (see Table 1). Each participant generated as many abstract and concrete words as possible within 2 minutes for each category. Participants also rated the cultural relevance of each category using a five-point Likert scale (not relevant – highly relevant) to assess how well it might connect with PWA in that cultural context. Responses were tallied for each participant, then collapsed across participants. Duplicates were removed and misspellings corrected. Average words produced and average relevance ratings were calculated and a Pearson correlation between these two values was conducted. The concreteness ratings for the English translations were obtained from the Brysbaert database (Brysbaert et al., 2014) and a ratio of abstract to concrete words was calculated.

Results

See Table 1 and Figure 1 for details. Participants produced an average of 24.9 to 39.5 words per category, with at least 40 words in each category produced by at least 2 participants. The average rating of relevance ranged from 3.23 to 5 (moderately to highly relevant). There was no significant relationship between the number of words produced and the cultural relevance of the category ($r = -0.20$, $p = 0.57$). Although some high-relevance categories (e.g., Wedding, School) elicited a larger number of words, others like football produced the highest word count despite having the lowest relevance score. The abstract to concrete word ratio ranged from 29% to 88%, meaning that while some

categories elicited relatively few abstract words, others elicited nearly equal numbers of abstract and concrete words.

Conclusions

Participants in this study produced a large number of words per category, with considerable overlap among participants. Also, the ratio of abstract to concrete words was fairly high for most categories. This bodes well for developing stimuli for BAbSANT therapy. Additionally, participants rated categories as having moderate to high cultural relevance. Thus, potentially any of these categories could be meaningful for a Persian-speaking client and would be acceptable to use in therapy. Unexpectedly, cultural relevance was not related to the number of words produced in each category. This may be an interesting area for future research.

References

- Asadi, M., Yadegari, F., Ghasisin, L., & Bakhshi, E. (2014). *Semantic Feature Analysis Treatment for Anomia of two nonfluent Persian-speaking aphasic patients*. 12(21).
- Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40 thousand generally known English word lemmas. *Behavior Research Methods*, 46(3), 904–911. <https://doi.org/10.3758/s13428-013-0403-5>
- Kiran, S., Sandberg, C., & Abbott, K. (2009). Treatment for lexical retrieval using abstract and concrete words in persons with aphasia: Effect of complexity. *Aphasiology*, 23(7–8), 835–853. <https://doi.org/10.1080/02687030802588866>
- Lupyan, G., & Winter, B. (2018). Language is more abstract than you think, or, why aren't languages more iconic?. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1752), 20170137.
- Sadeghi, Z., Baharloei, N., Moddarres Zadeh, A., & Ghasisin, L. (2017). Comparative Effectiveness of Semantic Feature Analysis (SFA) and Phonological Components Analysis (PCA) for Anomia Treatment in Persian Speaking Patients With Aphasia. *Iranian Rehabilitation Journal*, 15(3), 259–268. <https://doi.org/10.29252/nrip.irj.15.3.259>
- Sandberg, C. W., Khorassani, H., Gray, T., & Dickey, M. W. (2023). Novel participant-level meta-analytic evidence for AbSANT efficacy. *Frontiers in Rehabilitation Sciences*, 4. <https://doi.org/10.3389/fresc.2023.1017389>
- Sandberg, C. W., Zacharewicz, M., & Gray, T. (2021). Bilingual Abstract Semantic Associative Network Training (BAbSANT): A Polish-English case study. *Journal of Communication Disorders*, 93, 106143. <https://doi.org/10.1016/j.jcomdis.2021.106143>

Acknowledgments

Funding was provided by Penn State's Center for Language Science (CLS) Dissertation Improvement Award.

Figure 1.

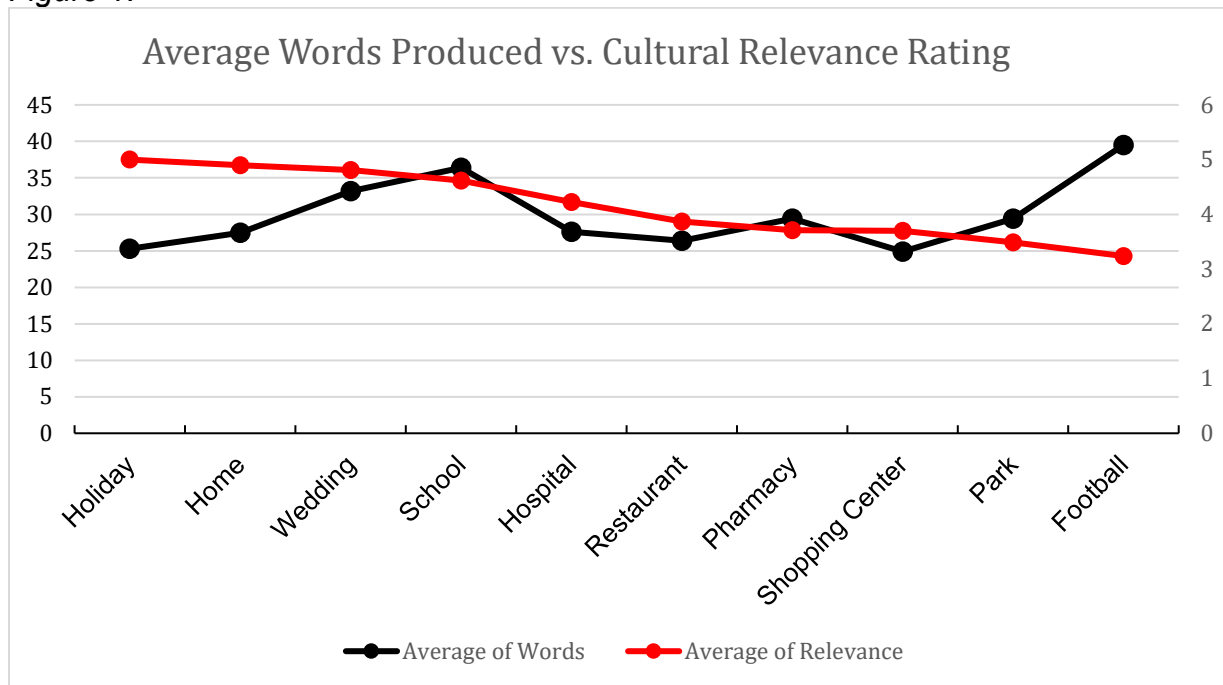


Table 1. Word Generation Descriptive Statistics

Category	Average Words Produced	Average Relevance Rating	Abstract Word/Concrete Word Ratio
Holiday	25.3	5	68%
Home	27.5	4.89	29%
Wedding	33.2	4.81	59%
School	36.4	4.61	80%
Hospital	27.6	4.22	80%
Restaurant	26.4	3.87	62%
Pharmacy	29.4	3.71	79%
Shopping Center	24.9	3.69	88%
Park	29.4	3.48	33%
Football	39.5	3.23	74%

Applications of Noninvasive Brain Stimulation to the Treatment of Post-stroke and Progressive Aphasias

¹Aneta Kielar, ²Olga Boukrina, ³Priyanka Shah-Basak

¹Speech, Language and Hearing Sciences, University of Arizona, Tucson, AZ, USA,

²Center for Stroke Rehabilitation Research, Kessler Foundation, East Hanover, NJ, USA

³Neurology, Medical College of Wisconsin, Milwaukee, WI, USA

***corresponding author, akielar@arizona.edu**

Introduction

Deficits in phonological processing are often observed in individuals with aphasia, affecting all modes of communication, including speech comprehension, production, reading and writing. This symposium will discuss personalized transcranial electrical stimulation (tES) combined with phonological interventions in primary progressive aphasia (PPA) and post-stroke aphasia. Outcomes include reading, writing, phonological short-term memory (pSTM), and neuroimaging.

Structure

Session 1

Presenting Author: Aneta Kielar; Co-Authors: Katlyn V. Nickels, Pelagie, Beeson. In this double-blinded, cross-over study, the phonological manipulation intervention was combined with transcranial direct current stimulation (tDCS). Twelve individuals with logopenic and nonfluent PPA were randomized to receive active tDCS-first or sham-first. The placement of electrodes was guided by structural and functional MRI and current flow modelling. Both treatment groups (tDCS-first and sham-first) improved in phonological transcoding skills, but those who received active tDCS-first showed stronger gains in phonological manipulation ability. The tDCS-first group showed positive changes in written narratives, containing more grammatical sentences with increased meaningful content and more accurate spelling. Positive outcomes were strongest and maintained longer when tDCS was combined with behavioral treatment from the beginning, suggesting that this combination may potentiate positive changes that extend beyond the treatment period.

Session 2

Presenting Author: Olga Boukrina, Co-Authors: Elizabeth B. Madden, William W. Graves, and Priyanka Shah-Basak. Treatments targeting phonology, such as Phono-Motor Treatment (PMT), can lead to meaningful gains in reading outcomes, but PMT requires an intensive multi-week regimen. We are investigating the efficacy of tDCS in combination with a modified PMT targeting reading to enhance treatment effectiveness and reduce its duration. I will describe preliminary data with tDCS, administered during the 1st or 2nd half of PMT, or on alternate days during six weeks of treatment. Stimulation will target left posterior parietal cortex, implicated in phonological processing. Reading aloud, phonological awareness, and broader language skills at baseline, mid-treatment, and

post-treatment will be assessed. I will also describe the foundational work that motivated this project, including our longitudinal neuroimaging study and early findings from ongoing PMT trials.

Session 3

Presenting Author: Priyanka Shah-Basak; Co-authors: Katrina Erickson, Sara Pillay, Jeffrey Binder. We investigated whether transcranial alternating current stimulation (tACS) can modulate pSTM in 13 stroke survivors with aphasia (SWA), a population in which tACS application remains underexplored. Using a within-subject, single-blinded, design, we delivered theta tACS targeting left temporoparietal and inferior frontal regions across three sessions: in-phase, anti-phase and sham tACS. An adaptive delayed match-to-sample task involving spoken syllables was administered before, during and after tACS. The number of syllables maintained (capacity) was the primary outcome. I will present preliminary evidence of in-phase theta tACS benefits on pSTM capacity, discuss challenges with tACS durability and individual variability, and outline how these findings have informed ongoing tACS optimization studies.

Interest to the Academy

This symposium will discuss evidence regarding the application of tES as an adjuvant to phonological skills training in PPA and post-stroke aphasia. Both behavioral and neuroimaging outcomes will be discussed.

Selected References

- Boukrina O, Madden EB, Sandroff BM, Cui X, Yamin A, Kong Y, Graves WW. Improving reading competence in aphasia with combined aerobic exercise and phono-motor treatment: Protocol for a randomized controlled trial. *PLoS One*. 2025 Jan 16;20(1):e0317210. doi: 10.1371/journal.pone.0317210. PMID: 39820216; PMCID: PMC11737671.
- Boukrina O, Madden EB, Giordano N, Karim D, Staples R, Graves WW. Targeting Phonology or Semantics to Improve Reading Aloud Response Times and Accuracy: A Case Series Investigation of Stroke Survivors With Aphasia. *Am J Speech Lang Pathol*. 2024 Dec 12;33(6S):3263-3295. doi: 10.1044/2024_AJSLP-23-00364. Epub 2024 Aug 15. PMID: 39146330.
- Nickels, K., Beeson, P. M., & Kieler, A. (2025). Addressing Phonological Deficit in Primary Progressive Aphasia with Behavioral Intervention and Transcranial Direct Current Stimulation. *Journal of speech, language, and hearing research : JSLHR*, 1–38. Advance online publication. https://doi.org/10.1044/2024_JSLHR-24-00250

Acknowledgments

Authors thank individuals with aphasia and their families for contributing their time to the studies presented in this symposium. Aneta Kieler's research was supported by the Arizona Alzheimer's Consortium Grant, The Arizona Department of Health Services (ADHS) and the state of Arizona (ADHS Grant No. CTR057001); The Arizona Alzheimer's Disease Research Center (P30AG072980); Innovations in Healthy Aging: Grand Challenges of Aging Seed Grant, The University of Arizona Health Sciences

(2259304); and Data Science Academy–Transdisciplinary Research in Principles of Data Science at The University of Arizona (2259910).

Investigating Speech Pauses and Rhythm in Aphasia: A Usage-Based Approach

Jieun Kim^{1*}, Mara Breen¹, and Rosemary Varley²

¹ Department of Psychology, Mount Holyoke College, South Hadley, Massachusetts, United States of America

² Department of Language and Cognition, University College London, London, United Kingdom

*Jieun Kim, kim72j@mtholyoke.edu

Introduction

Aphasia is a language disorder that typically results from stroke or brain injury that affects the fluency of speech production. Traditional generative models attribute speech pauses in aphasia to breakdowns in syntactic processing, particularly when constructing grammatically complex utterances (Friedmann & Grodzinsky, 1997). In contrast, usage-based theories propose that pauses reflect the cognitive effort involved in retrieving entrenched linguistic patterns shaped by prior experience and frequency of exposure (Bybee, 2010; Bello-Lepe et al., 2024). While past studies have looked at pauses as markers of grammatical disruption, there hasn't been much focus on the role of phrase frequency and collocational strength. This research aims to fill that gap by analyzing the speech of individuals with aphasia (IWA) from a usage-based perspective. We hypothesize that high-frequency phrases and stronger collocation strength will be associated with fewer and shorter pauses, reflecting more automatic retrieval. We will also examine if rhythmic irregularities in aphasic speech vary depending on lexical retrieval demands to explore how linguistic experience shapes prosodic timing.

Methods

We will extract speech recordings from 15 individuals with Broca's aphasia and 15 neurotypical controls (NBD) from AphasiaBank. We will then annotate the audio recordings in Praat, using a four-tier system, to capture pauses, either silent (>250ms), filled (e.g., "uh"), or absent (<250ms), alongside transcription. Specifically, we will measure the duration of the pauses and their position regarding word and grammatical boundaries. Lexical frequency will be calculated using the log-transformed norms of the spoken sub-corpus of the Corpus of Contemporary American English (CoCA). The statistical association of co-occurring words, represented by t-scores for bigrams and trigrams, will be used to measure the strength of collocation. Rhythmic structure will be described with the pairwise variability index (PVI) in syllables per second (speech rate) and inter-syllable intervals. We will use linear mixed-effects models to examine whether pause duration is predicted by phrase frequency, collocation strength, and interactions. Participant ID and item variance will be random effects. We will assess inter-annotator reliability using Cohen's κ (>0.80) for pause categorization, and intraclass correlation coefficients (>0.90) for duration measurements.

Results

Consistent with usage-based theory and prior research (Bello-Lepe et al., 2024), we anticipate people with Broca's aphasia to produce relatively longer and more pauses than neurotypical controls as a group, moderated by linguistic experience. We expect to see shorter pauses preceding high-frequency words and strongly collocated phrases, implying greater automaticity in their retrieval. We also expect more irregular timing through rhythmic analysis in the produced speech of aphasic individuals, although their timing patterns may mimic neurotypical prosody more closely upon comparing high-frequency constructions. Our findings suggest that language experience, not just grammatical deficits, influences pauses and rhythm in aphasia.

Conclusion

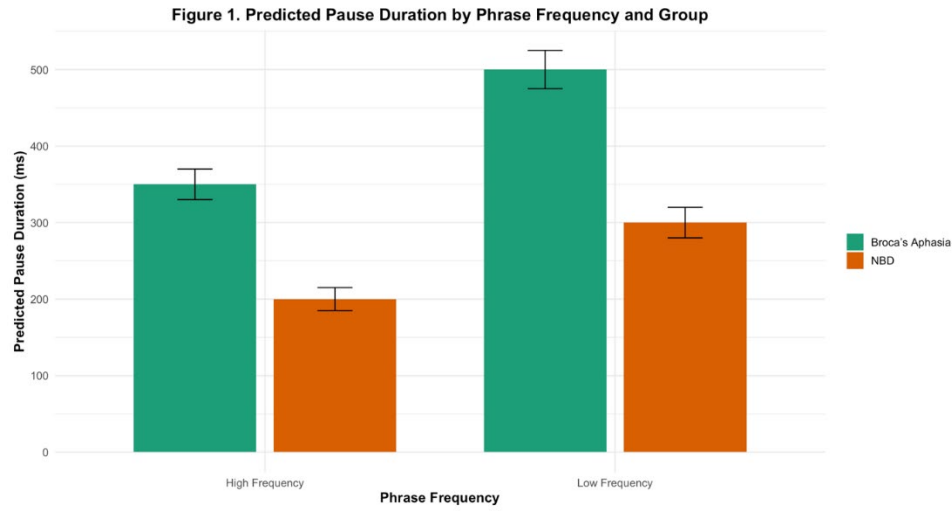
This study aims to investigate how linguistic experience shapes speech pauses and rhythm in aphasia. Findings will be interpreted concerning usage-based models of language processing, contributing to ongoing theoretical debates. Clinically, identifying the role of frequently used and well-practiced language structures could inform fluency-oriented interventions. Future research should explore how phrase frequency and prosodic features interact to support language rehabilitation.

References

- Bello-Lepe, S., Mahmood, S., Varley, R., & Zimmerer, V. (2024). Speech pauses in speakers with and without aphasia: A usage-based approach. *Cortex*, 178, 287-298. <https://doi.org/10.1016/j.cortex.2024.06.012>
- Bybee, J. (2010). *Language, usage and cognition*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511750526>
- Friedmann, N., & Grodzinsky, Y. (1997). Tense and agreement in agrammatic production: Pruning the syntactic tree. *Brain and Language*, 56(3), 397-425. <https://doi.org/10.1006/brln.1997.1795>
- MacWhinney, B. (2019). Understanding spoken language through TalkBank. *Behavior Research Methods*, 51(4), 1919-1927. <https://doi.org/10.3758/s13428-018-1174-9>

Acknowledgements

I would like to thank Professor Mara Breen for her continued mentorship and feedback throughout this project. I am also grateful to Professor Rosemary Varley and the Cognition and Grammar Lab at University College London for the formative research experience that inspired this study. I thank the AphasiaBank project (NIH-NIDCD R01DC008524) for access to the data.



A Time-Efficient Naming Assessment for Korean Speakers with Aphasia Using the Rapid Naming Test

So Eun Kim¹, Junyoung Shin¹, Sujin Choi¹, Boon Lead Tee² and
Jee Eun Sung^{1*}

¹ Department of Communication Disorders, Ewha Womans University, Seoul, Korea

² Department of Neurology, University of San Francisco, California, USA

*corresponding author, jeesung@ewha.ac.kr

Introduction

Word retrieval difficulty is a hallmark of language impairment in people with aphasia(PWA), manifesting across aphasia types and often leading to naming difficulty (Goodglass & Kaplan, 1983). Accurate and efficient evaluation of naming deficits is essential for clinical diagnosis and treatment planning (Laine & Martin, 2006). Traditional naming tests such as Boston Naming Test (BNT; Kaplan et al., 2001) are time-consuming, labor-intensive, and does not effectively reflect lexical retrieval function, thus limiting its validity in clinical settings (Del Toro et al., 2010).

To address these limitations, the Rapid Naming Test (RNT) was introduced as a one-minute naming task aimed at assessing lexical retrieval efficiency within a limited time window. The RNT has been validated for English speakers and shown to be sensitive to age-related changes in language abilities, supporting its ecological validity as a time-efficient measure of naming performance (Stiver et al., 2022).

The present study aimed to develop a culturally and linguistically adapted version of the RNT for Korean speakers and to conduct preliminary investigations into its clinical utility and feasibility for Korean-speaking individuals with aphasia. Specifically, we examined whether the RNT reliably differentiates PWA from healthy controls (HC) and whether RNT performance predicts overall aphasia severity, as measured by the Aphasia Quotient (AQ) from the Paradise Korean version of the Western Aphasia Battery-Revised (PK-WAB-R; Kim & Na, 2012).

Methods

Participants

A total of 32 Korean speakers participated in the study, including 12 individuals with aphasia and 20 age- and education-matched HC (see Table 1). All PWA were diagnosed with aphasia due to a stroke in the language-dominant hemisphere, as confirmed by the PK-WAB-R.

Task

Participants were instructed to name as many of the 60 black-and-white line drawings as possible within one minute. RNT accuracy was measured by calculating the total number of correctly named items for each participant.

Data Analysis

A one-way ANOVA was conducted to compare RNT scores between the PWA and control groups. Within the PWA group, linear regression was used to examine whether RNT scores predicted AQ scores. Stepwise regression was performed to identify which WAB

subtest was most strongly associated with RNT performance. Receiver Operating Characteristic (ROC) analysis was also conducted to evaluate the discriminative ability of RNT scores in distinguishing PWA from H

Results

Higher accuracy was observed in the HC compared to the PWA group ($F_{(1, 30)}=32.084$, $p<.001$, partial $\eta^2=.517$). Within the PWA group, the accuracy on the RNT significantly predicted overall aphasia severity ($R^2=.607$, $p=.003$). Of the WAB subtests, only *naming* significantly predicted RNT performance ($R^2=.662$, $p=.001$). ROC analysis confirmed that the RNT effectively distinguished individuals with PWA from controls (AUC=.889) (Figure 1).

Conclusions

The findings suggest that the Korean-RNT is sensitive in identifying lexical retrieval and semantic knowledge impairments in individuals with aphasia from healthy controls, extending the work of Stiver et al. (2022) to a clinical population. RNT scores were significantly associated with overall aphasia severity and naming performance, further supporting its clinical utility in assessing lexical retrieval deficits. Given its brief administration time and strong classification accuracy, the RNT shows promise as an efficient screening tool for identifying naming deficits in aphasia. To further validate the Korean-RNT, studies with larger sample sizes and applications across diverse clinical populations are warranted.

References

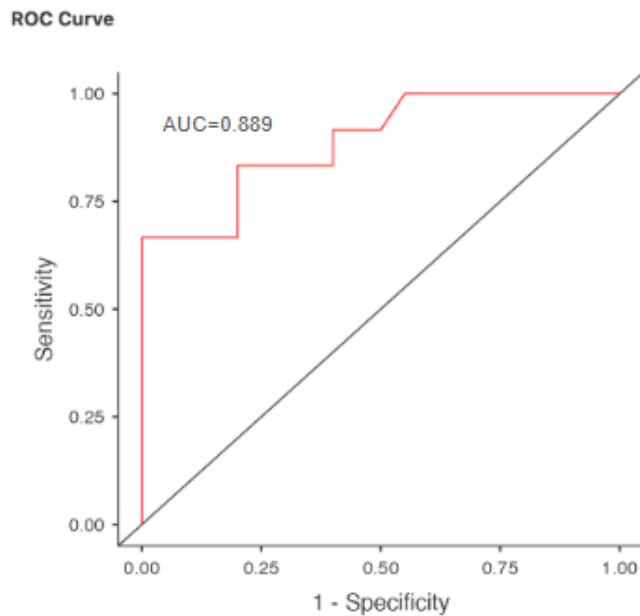
- Goodglass, H., & Kaplan, E. (1983). Boston diagnostic aphasia examination PA: Williams & Wilkins.
- Laine, M., & Martin, N. (2006). Anomia: theoretical and clinical aspects NY: Psychology Press.
- Kaplan, E., Goodglass, H., & Weintraub, S. (2001). Boston Naming Test (2nd ed.). Lippincott Williams & Wilkins.
- Del Toro, C. M., et al. (2010). Development of a Short Form of the Boston Naming Test for Individuals with Aphasia. *Journal of Speech, Language, and Hearing Research*, 53(6), 1229–1239.
- Stiver, J., Staffaroni, A. M., Walters, S. M., You, M. Y., Casaletto, K. B., Erhoff, S. J., ... & Kramer, J. H. (2022). The Rapid Naming Test: Development and initial validation in typically aging adults. *The Clinical Neuropsychologist*, 36(7), 1822–1843. <https://doi.org/10.1080/13854046.2021.1900399>
- Kim, H., & Na, D. L. (2012). Paradise Korean-Western aphasia battery (revised) Seoul: Paradise.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Ministry of Science and ICT (MSIT) (No. 2022R1A2C2005062, RS-2024-00461617), by the National Research Council of Science & Technology (NST) grant funded by MSIT (No. CAP21054-000), by the NRF grant funded by the Ministry of Education (No. NRF-2022R111A4063209), and by the Korea Health Technology R&D

Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare (No. HI23C0156).

Figure 1. ROC curve for RNT scores differentiating PWA from HC



Note. ROC = Receiver Operating Characteristic; PWA = people with aphasia; HC = Healthy controls; AUC = Area Under Curve

Table 1. Descriptive statistics for demographic and clinical variables in the aphasia group

	PWA (n=12)	HC (n=20)	F	p
	Mean (SD)	Mean (SD)		
Age (yrs)	48.00 (13.44)	55.05 (17.80)	1.313	.246
Education (yrs)	14.00 (2.27)	14.05 (3.25)	1.388	.963
RNT total score (/60)	21.58 (13.67)	42.70 (7.51)	32.084	<.001
Aphasia Quotient (AQ)	77.67 (17.59)	-	-	-
Fluency(/10)	6.50 (2.47)	-	-	-
Comprehension (/10)	8.36 (1.60)	-	-	-
Repetition(/10)	7.43 (3.34)	-	-	-
Naming(/10)	8.60 (1.28)	-	-	-

Note. PWA = people with aphasia; HC = Healthy controls; RNT = Rapid Naming Test; AQ = Aphasia Quotient from the Paradise Korean version of the Western Aphasia Battery-Revised (PK-WAB-R)

Network-Level Involvement in Slower Language Processing Speed in Glioma Patients: A Multimodal Neuroimaging Study

Ryuta Kinno^{1,2 *}, Manabu Tamura³, Takashi Maruyama^{3,4}, Yoshihiro Muragaki^{3,5}, Ayako Osanai¹, Satomi Kubota¹, Akinori Futamura¹, and Kuniyoshi L. Sakai²

¹ Department of Neurology, Showa Medical University Fujigaoka Hospital, Kanagawa, Japan

² Department of Basic Science, Graduate School of Arts and Sciences, The University of Tokyo, Tokyo, Japan

³ Department of Neurosurgery, Tokyo Women's Medical University, Tokyo, Japan

⁴ Department of Neurosurgery, Utsunomiya Symphony Hospital, Tochigi, Japan

⁵ Department of Medical Device Engineering, Kobe University, Kusunoki-cho, Kobe, Japan

*Corresponding author, kinno@med.showa-u.ac.jp

Introduction

Gliomas, a class of primary brain tumors, are known to impair cognitive functions, especially the speed of language processing at both lexical and sentence levels (Mooijman et al., 2022). However, the neural mechanisms underlying these deficits are not fully understood. This study aims to explore how diffuse gliomas impact the large-scale brain networks supporting language processing speed, using multimodal neuroimaging techniques.

Methods

We examined twenty-eight right-handed patients with left-hemispheric WHO grade II or III gliomas and twenty-three age- and gender-matched healthy participants. All underwent two behavioral tasks: a picture-sentence matching task (assessing both lexical and sentence-level processing), and a symbol-matching task (targeting lexical processing). Performance was measured by accuracy and response times (RTs). Imaging analyses included: voxel-based lesion-symptom mapping (VLSM) to identify lesion locations related to slower processing speed, surface-based morphometry (SBM) to detect changes in cortical thickness (CT) and gyrification index (GI), and diffusion MRI-based tractography using a healthy brain template to explore inter-regional structural connectivity.

Results

Regarding the behavioral performance, while patients performed with similar accuracy to healthy participants, they exhibited significantly longer RTs on both tasks, indicating slowed processing speed. VLSM revealed that gliomas in the white matter near the triangular part of the left inferior frontal gyrus (F3t) were associated with prolonged RTs. SBM showed widespread cortical thinning and increased gyrification, particularly in the right insular cortex, which correlated with slower RTs. Tractography indicated that the left F3t and right insular cortex are structurally connected via the middle longitudinal fasciculi,

inferior fronto-occipital fasciculi, and the genu of the corpus callosum (GCC). Notably, fibers through the GCC were uniquely associated with language processing speed.

Conclusions

This study suggests that slower language processing speed in glioma patients is not solely due to local damage, but reflects a broader involvement of interconnected brain networks, including the left F3t, right insular cortex, and interhemispheric connections via the GCC. These findings indicate that glioma-related cognitive impairments may arise from network-level dysfunction and adaptive neuroplastic changes, rather than simple fiber disruption. Clinically, this supports the need for network-aware surgical and rehabilitative strategies to better preserve language functions in glioma patients.

References

Mooijman, S., Bos, L. S., De Witte, E., Vincent, A., Visch-Brink, E., & Satoer, D. (2022). Language processing in glioma patients: speed or accuracy as a sensitive measure? *Aphasiology*, 36(12), 1467-1491.

Naturalistic versus modular and controlled assessment of language processing in aphasia

Swathi Kiran¹, William Graves², Elena Barbieri³, Einat Liebenthal⁴, Sam Nastase⁵

¹Center for Brain Recovery, Boston University

² Department of Psychology, Rutgers University

³ Mesulam Center for Cognitive Neurology and Alzheimer's Disease, Northwestern University

⁴ Institute of Technology, McLean Hospital, Harvard University

⁵ Department of Psychology, Princeton University

***corresponding author, kirans@bu.edu**

Introduction

The assessment of language in individuals with aphasia has traditionally relied on modular paradigms that isolate specific components of language—such as phonology, semantics, and syntax—using highly controlled experimental tasks and stimuli. These approaches have led to the development of sophisticated and standardized tools for identifying impaired language functions and mapping their neural correlates. However, there is growing recognition that language does not operate in isolation from other cognitive, emotional, and social processes. Naturalistic paradigms, which aim to engage the brain more similarly to real-life, are gaining traction for their ability to capture language function in context. Naturalistic paradigms involve processing complex stimuli such as movies or narratives, or even open-ended conversation, allowing researchers to study language dynamically and holistically. This symposium brings together a diverse set of behavioral, neurophysiological, and computational methodologies to foster discussion on the challenges and benefits of modular versus naturalistic approaches.

Structure

1. William Graves, Rutgers University

Using controlled stimuli to map language cortex and select reading treatments in aphasia

William Graves will discuss how using tightly controlled stimuli to map language cortex with functional magnetic resonance imaging (fMRI) can guide computationally-based selection of phonological versus semantic interventions for reading impairment in aphasia¹.

2. Elena Barbieri, Northwestern University

Modular and naturalistic approaches to the investigation of agrammatism in Primary Progressive Aphasia.

Elena Barbieri will explore the contributions of modular versus naturalistic methods to investigate agrammatism in Primary Progressive Aphasia (PPA), and with respect to their ability to differentiate between PPA subtypes and etiologies².

3. Einat Liebenthal, McLean Hospital, Harvard University

Naturalistic movie-watching for studying discourse-level spoken-language communication in stroke-induced aphasia.

Einat Liebenthal will discuss insights from naturalistic movie-watching to examine discourse-level spoken language processing in stroke-induced aphasia, highlighting how this paradigm can reveal patterns of communication that are difficult to capture with traditional tasks³.

4. Sam Nastase, Princeton University

Modeling the linguistic structure of brain-to-brain coupling in natural conversations.

Sam Nastase will discuss computational modeling of dyadic neural activity recorded with electrocorticography or hyperscanning fMRI during real-time conversation, providing a window into the brain's dynamic language networks during natural interaction⁴.

5. Open discussion moderated by Swathi Kiran (Boston University).

At the end of the symposium, the panel will discuss questions including (1) the trade-offs and balance between controlled experimental paradigms and naturalistic approaches, (2) what naturalistic paradigms reveal about language networks that traditional tasks cannot, (3) the dynamic nature of language processing during real-time interaction and controlled conditions, (4) the role of computational modeling in bridging laboratory findings with real-world language, and (5) the evolution of language neuroscience from isolated tasks to naturalistic contexts.

Interest to the Academy

This symposium will be of great interest to researchers studying language processing in aphasia by showcasing both modular and naturalistic paradigms. It highlights innovative methods—from controlled stimuli for mapping language cortex to conversation-based paradigms—that capture language use in real-world contexts. By comparing structured assessments with dynamic, ecologically valid approaches, the talks offer valuable insights into the neural and cognitive mechanisms of language.

Selected References

- Boukrina O, Madden EB, Giordano N, Karim D, Staples R, **Graves W** (2024). Targeting phonology or semantics to improve reading aloud response times and accuracy: a case series investigation of stroke survivors with aphasia. *Am J Speech Language Pathol*, 33(6S):3263-3295.
- Mack JE, **Barbieri E**, Weintraub S, Mesulam MM, Thompson CK (2021). Quantifying grammatical impairments in primary progressive aphasia: Structured language tests and narrative language production. *Neuropsychologia*, 151: 107713.
- Girard MG, Tie Y, **Liebenthal E**. DynAMoS: The dynamic affective movie clip database for subjectivity analysis (2023). *Int Conf Affect Comput Intell Interact Workshops*, 10.1109/acii59096.2023.10388135.
- Zada, Z., Goldstein, A. Y., Michelmann, S., Simony, E., Price, A., Hasenfratz, L., Barham, E., Zadbood, A., Doyle, W., Friedman, D., Dugan, P., Melloni, L., Devore, S., Flinker, A., Devinsky, O., Hasson, U. *, & **Nastase, S. A. *** (2024). A

shared model-based linguistic space for transmitting our thoughts from brain to brain in natural conversations. *Neuron*, 112(18), 3211–3222. <https://doi.org/10.1016/j.neuron.2024.06.025>

A Comparison of face-to-face versus tele-mode of Intensive and Comprehensive Aphasia Program (ICAP) for Cantonese speakers in Hong Kong

Anthony Pak-Hin Kong^{1,2*}, Cherie Wan-Yin Wong^{1,2} and Ada Wai-Sze Chu^{1,2}

¹ Academic Unit of Human Communication, Learning, and Development, The University of Hong Kong, Hong Kong SAR

² Aphasia Research and Therapy (ART) Laboratory, The University of Hong Kong, Hong Kong SAR

***corresponding author, akong@hku.hk**

Introduction and Aims

As summarized by Nicholas et al. (2022), an Intensive and Comprehensive Aphasia Program (ICAP) provides a minimum of 3 hours of daily treatment over at least 2 weeks to a cohort of participants. An ICAP is also required to be comprehensive, consists of individual and group therapy, education, and use of technology to target impairment and participation level functions. ICAP has been garnering increasing attention because it addressed people with aphasia (PWA)'s needs for intensive and holistic treatment (Rose et al., 2013). Recent studies also supported the effectiveness of conducting assessment and treatment via tele-practice as no significant score and result differences were observed between in-person therapy and tele-practice (Fabian et al, 2020; Woolf et al., 2016; Zhou et al., 2018). Owing to the conduction of ICAP via tele-practice was not popular a decade ago, there has been a void of knowledge on the efficacy of virtual ICAP. This study first aims at developing a new model that infuse evidence-based aphasia practice into ICAP in the Hong Kong Chinese context and implementing it through in-person and virtual therapy. Then, it compares the treatment effects of the two service delivery modes on PWA's linguistics and quality of life outcomes. Lastly, it will discuss the potential differences in participant recruitment and cohort formation when delivering virtual ICAP.

Methods

Twenty-six Cantonese-speaking adults (21 males) with chronic aphasia resulting from a single unilateral, left hemisphere stroke were recruited. Participants had a mean age of 64- and 56-year-old for in-person ICAP and virtual ICAP respectively; while the former group had a mean post-onset of 2;09 and the later one was 3;07. All participants received a dosage of 39 treatment hours, comprised with 12-hour impairment-based treatment, 12-hour functional-based treatment, 9-hour computer/app-based training and 6-hour group therapy. This ICAP had an intensity of 15-hour/week and a frequency of 5-time/week. It is a nonrandomized, pre-post intervention study; participants were allocated into group based on the time of recruitment and their availability to attend the treatment program. Multiple baselines were measured before treatment and standardized tests ranging from word to discourse level were taken.

Results and Conclusions

Individual data and group analysis of aphasia quotient (AQ) in Cantonese version of Western Aphasia Battery and language scores of the Cantonese version of Comprehensive Aphasia Test (Kong, 2024) indicated a promising language improvement, in which no significant differences were observed between in-person and virtual ICAP. Both service delivery modes indicated similar prolonged treatment effects as reflected by non-significant difference of AQ scores between immediate and one-month follow-up post-test. Specifically, improvements were found in word- and discourse-level language functions and psychosocial aspect of communication. The in-person ICAP and virtual ICAP group shared similar therapeutic effects on PWA's language skills and quality of life aspects in this study, suggesting both service modes are comparable to each other, i.e., virtual ICAP is a feasible intervention model. This study also highlights the implementation differences between the two service modes, including technical training sessions, on-site set-up specially for virtual ICAP.

References

- Fabian, R., Bunker, L., & Hillis, A. E. (2020). Is Aphasia Treatment Beneficial for the Elderly? A Review of Recent Evidence. *Current Physical Medicine and Rehabilitation Reports*, 8(4), 478–492. <https://doi.org/10.1007/s40141-020-00287-z>
- Kong, A. P.-H. (2024). An update on validating the Hong Kong Cantonese version of the Comprehensive Aphasia Test (cant-cat). *Aphasiology*, 1–23. <https://doi.org/10.1080/02687038.2024.2398807>
- Nicholas, M., Pittmann, R., Pennington, S., Connor, L. T., Ambrosi, D., Brady Wagner, L., Hildebrand, M., & Savastano, M. (2022). Outcomes of an interprofessional intensive comprehensive aphasia program's first five years. *Topics in Stroke Rehabilitation*, 29(8), 588–604. <https://doi.org/10.1080/10749357.2021.1970452>
- Rose, M., Cherney, L. R., & Worrall, L. E. (2013). Intensive Comprehensive Aphasia Programs: An international survey of practice. *Topics in Stroke Rehabilitation*, 20(5), 379–387. <https://doi.org/10.1310/tsr2005-379>
- Woolf C, Cauter A, Haigh Z, Galliers J, Wilson S, Kessie A, et al. (2016). A comparison of remote therapy, face to face therapy and an attention control intervention for people with aphasia: A quasi-randomised controlled feasibility study. *Clinical Rehabilitation*, 30(4), 359–73. <https://doi.org/10.1177/0269215515582074>
- Zhou, X., Du, M., & Zhou, L. (2018). Use of mobile applications in post-stroke rehabilitation: a systematic review. *Topics in Stroke Rehabilitation*, 25(7), 489–499. <https://doi.org/10.1080/10749357.2018.1482446>

Right Cerebellar Functional Connectivity Predicts Linguistic Abilities in Post-Stroke Aphasia

Emerson Kropp^{1*}, Nicole Carvalho¹, Rajani Sebastian², Swathi Kiran¹, and Maria Varkanitsa¹

¹ Center for Brain Recovery, Boston University, Boston, MA, USA

² Department of Physical Medicine and Rehabilitation, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

***corresponding author, ekropp@bu.edu**

Introduction

Although traditionally overlooked in aphasia research, the cerebellum, particularly the right Crus I/II, is increasingly recognized for its role in language (Booth et al., 2007; Stoodley & Schmahmann, 2008). Notably, functional connectivity of right cerebellar regions has been associated with linguistic abilities in subacute subcortical aphasia (Li & Xie, 2025) and chronic post-stroke aphasia (PSA) (Stilling et al., 2025). Beyond observational evidence, emerging neuromodulation studies further support the therapeutic potential of these regions in both healthy adults (Turkeltaub et al., 2016) and PSA (Sebastian et al., 2020). Building on this foundation, the current study investigates whether resting-state functional connectivity (FC) between right Crus I/II and cortical language regions predicts language performance in PSA.

Methods

We calculated ROI-to-ROI resting state FC between the right cerebellar Crus I/II (Cereb1/2) and 30 bilateral cortical language regions in 40 left hemisphere stroke patients with aphasia (mean age = 57.2; mean MPO = 77.6; mean years of education = 15; mean AQ = 80.1). For ROI pairs showing significant FC, values were extracted and entered into stepwise multiple linear regression models predicting Boston Naming Test (BNT) percent accuracy and Western Aphasia Battery – Revised Aphasia Quotient (WAB-R AQ). Models controlled for age, education, months post onset, and lesion volume.

Results

Stepwise regression models revealed that FC between Cereb1/2 and cortical language regions significantly predicted language performance in individuals with post-stroke aphasia. For naming ability (BNT %), three FC pairs emerged as significant predictors: Cereb2 R – Cereb2 L, Cereb2 R – pMTG L, and Cereb2 R – pITG R, with the overall model explaining 65% of the variance (Table 1). For overall aphasia severity (WAB-R AQ), Cereb2 R – Cereb2 L was significant again, with the full model explaining 72% of variance. Anova model comparisons confirmed that including cerebellar FC significantly improved performance over regression models using covariates alone for both outcomes (Table 1). In both models, higher FC between the seed regions and left hemisphere regions was associated with higher language scores; however, higher FC between seeds and right hemisphere regions (right pITG and Cereb8) negatively impacted performance (Table 1; Figure 1).

Conclusions

These findings underscore the critical role for the right cerebellum, particularly its connectivity with left hemisphere language areas, in supporting post-stroke language function. Greater FC between the right cerebellar Crus II and left temporal and contralateral cerebellar regions was associated with better naming and overall language performance. Conversely, increased FC within the right hemisphere was associated with worse behavioral scores, suggesting a potentially maladaptive compensatory mechanism involved in aphasia. These results align with prior evidence implicating Crus II in language recovery and support the idea that cerebellar functional connectivity may serve as a predictive biomarker and a promising neuromodulatory target in aphasia rehabilitation.

References

- Booth, J. R., Wood, L., Lu, D., Houk, J. C., & Bitan, T. (2007). The role of the basal ganglia and cerebellum in language processing. *Brain Research*, 1133(1), 136–144. <https://doi.org/10.1016/j.brainres.2006.11.074>
- Li, H., & Xie, X. (2025). Cerebellar activity and functional connectivity in subacute subcortical aphasia: Association with language recovery. *Neuroscience*, 565, 320–326. <https://doi.org/10.1016/j.neuroscience.2024.11.077>
- Sebastian, R., Kim, J. H., Brenowitz, R., Tippet, D. C., Desmond, J. E., Celnik, P. A., & Hillis, A. E. (2020). Cerebellar neuromodulation improves naming in post-stroke aphasia. *Brain Communications*, 2(2), fcaa179. <https://doi.org/10.1093/braincomms/fcaa179>
- Stilling, J., Kim, J. H., Cust, S., Keser, Z., Murter, J. L., Tippet, D. C., Hillis, A. E., & Sebastian, R. (2025). Cerebello-Cerebral Resting-State Functional Connectivity in Poststroke Aphasia. *Brain Connectivity*, 15(1), 40–54. <https://doi.org/10.1089/brain.2023.0087>
- Stoodley, C. J., & Schmahmann, J. D. (2009). Functional topography in the human cerebellum: A meta-analysis of neuroimaging studies. *NeuroImage*, 44(2), 489–501. <https://doi.org/10.1016/j.neuroimage.2008.08.039>
- Turkeltaub, P. E., Swears, M. K., D'Mello, A. M., & Stoodley, C. J. (2016). Cerebellar tDCS as a novel treatment for aphasia? Evidence from behavioral and resting-state functional connectivity data in healthy adults. *Restorative Neurology and Neuroscience*, 34(4), 491–505. <https://doi.org/10.3233/RNN-150633>

Acknowledgments

We are grateful to all our research participants and to the staff and collaborators who contributed to this work, including Anne Billot and Isaac Falconer. This study has been supported by the National Institutes of Health/National Institute on Deafness and Other Communication Disorders (Grant/Award Number: R01-DC016950).

Figure 1. Associations between right Crus II functional connectivity and language performance. Top row: FC between Cereb2 R–pMTG L (top left) and Cereb2 R–pITG R (top right) plotted against Boston Naming Test (BNT) percentage accuracy. Bottom row: FC between Cereb2 R–Cereb2 L plotted against BNT % (bottom left) and Western Aphasia Battery–Revised Aphasia Quotient (WAB-R AQ) (bottom right).

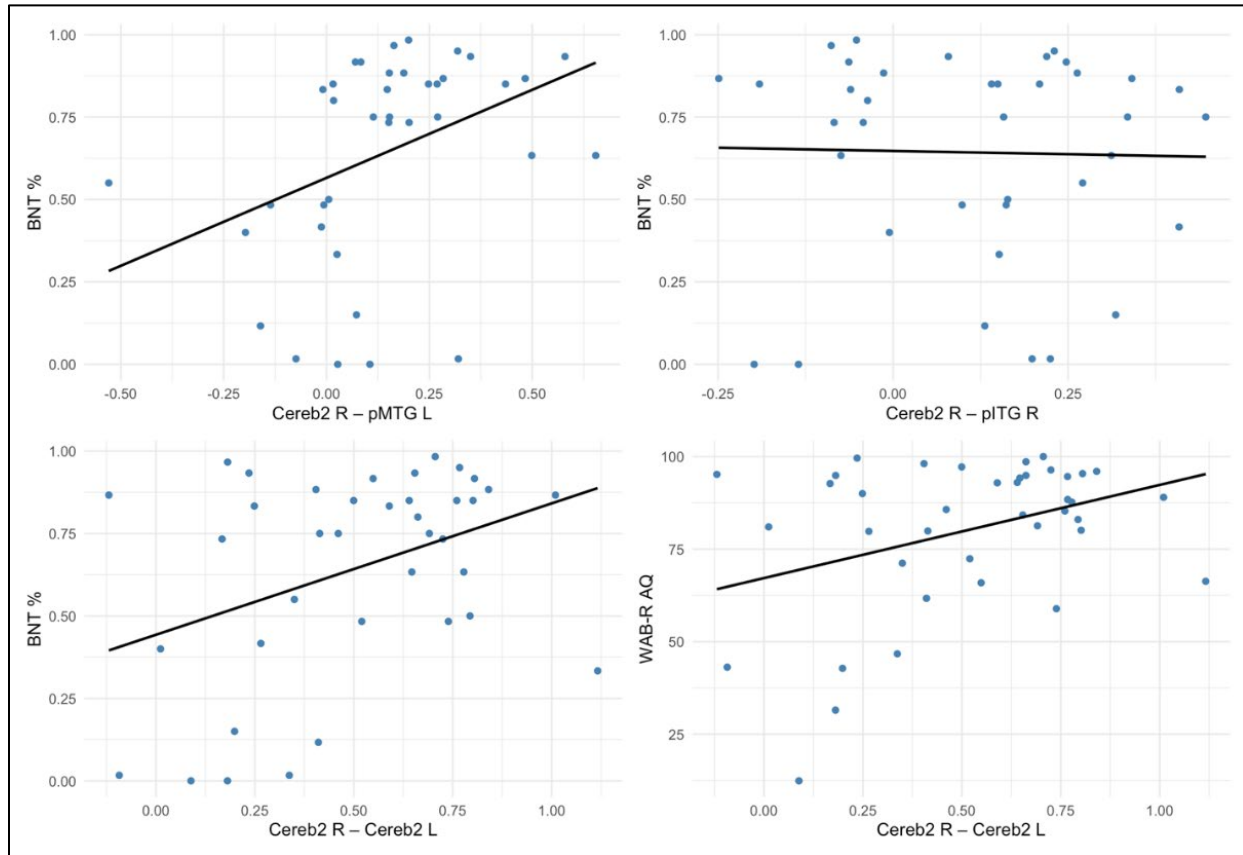


Table 1: Summary of final stepwise multiple linear regression models predicting BNT Percentage and WAB-R AQ (after feature reduction). P-values for model terms are FDR corrected; p-values (Bonferroni corrected) are provided for anova model comparison between the provided model and a baseline model containing only MPO, education, age, and lesion volume.

Outcome	Predictor	Std. β	Std. Error	t-value	p-value	Anova p-value
BNT %	(Intercept)	+0.03	0.10	0.27	.79	.0005
	Cereb2 R to Cereb2 L	+0.35	0.11	3.22	.01	
	Cereb2 R to pMTG L	+0.30	0.10	2.98	.01	
	Cereb2 R to pITG R	-0.29	0.11	-2.68	.02	
	Lesion Volume	-0.72	0.11	-6.65	< .001	
	Months Post Onset	+0.17	0.11	1.53	.16	
WAB-R AQ	(Intercept)	0.00	0.08	0.00	1.0	.0003
	Cereb2 R to Cereb2 L	+0.39	0.11	3.52	<.01	
	Cereb2 R to Cereb8 R	-0.22	0.10	-2.09	.08	
	Cereb1 R to Cereb1 L	+0.18	0.10	1.74	.12	
	Cereb2 R to AG L	+0.17	0.10	1.79	.12	
	Cereb2 R to aMTG L	-0.15	0.10	-1.46	.17	
	Cereb1 R to pMTG L	+0.18	0.10	1.73	.12	
	Months Post Onset	+0.36	0.10	3.59	<.01	
	Education	+0.35	0.10	3.55	<.01	
	Age	-0.27	0.11	-2.49	.04	
	Lesion Volume	-0.73	0.09	-7.90	<.001	

Language Network Reorganization after Stroke: Effects of Aphasia Type and Severity

Svetlana V. Kuptsova^{1*}, Ava M. Singh¹ and Arianna N. LaCroix¹

¹ Department of Speech, Language, and Hearing Sciences, Purdue University, West Lafayette, IN 47907, USA

*corresponding author, skuptsov@purdue.edu

Introduction

Language networks may reorganize through different compensatory pathways following left hemisphere stroke in people with and without aphasia. Although aphasia severity is a strong predictor of recovery from aphasia, its specific impact on resting-state functional connectivity remains less clear, as does its impact on type. This study examined patterns of functional connectivity and their relationship to aphasia severity and type.

Methods

Fifty-three participants with left hemisphere stroke from the Aphasia Recovery Cohort (Gibson et al., 2024) were included in this study: 14 without aphasia, 23 with anomic aphasia (Western Aphasia Battery Aphasia Quotient (WAB-AQ):72-93), and 16 with Broca's aphasia (WAB-AQ: 52-78).

Preprocessing was conducted using SPM12, and postprocessing using the CONN 18b Connectivity Toolbox. Lesions were excluded from the analysis for each participant. Age and WAB-AQ scores were included as covariates. ROI-to-ROI analyses were performed, with ROIs selected from cortical areas involved in language processing within the dorsal and ventral dual-stream networks (Labache et al., 2019; Zhu et al., 2025), and their right hemisphere homologues. ROI-to-ROI connectivity thresholds were set at $p < 0.05$, with p-FDR correction applied at the seed-level (two-sided).

Results

The right inferior frontal gyrus (IFG) was positively connected to the left precentral sulcus in the no aphasia group and the right superior temporal gyrus in the anomic group. In the Broca group, negative connectivity was found between the left middle temporal gyrus and the bilateral superior temporal sulci, and between the left angular gyrus and the right superior temporal sulcus.

Functional connectivity did not relate to aphasia severity within the Anomic group. However, within Broca's aphasia, functional connectivity negatively related to aphasia severity, indicating that less severe aphasia was associated with stronger connectivity between identified regions.

Conclusions

Significant connectivity patterns were identified for each aphasia type, possibly reflecting distinct compensatory mechanisms. In the no aphasia group, the connection between the right IFG and left precentral area may reflect the integration of right hemisphere cognitive control resources with left hemisphere dorsal stream motor planning resources,

supporting more efficient language processing. In the anomic group, the connection between the right IFG and right temporal area may reflect compensatory recruitment of right hemisphere homologues to support lexical retrieval, particularly in response to disruptions in the left hemisphere's ventral stream, which supports sound to meaning mapping for language comprehension and lexical retrieval. Within Broca's aphasia, the observed negative connectivity may reflect a compensatory interhemispheric dynamic in which left hemisphere language regions downregulate homologous right hemisphere activity, particularly in the ventral stream, in an effort to streamline lexical-semantic processing. This mechanism may be more pronounced in individuals with more severe Broca's aphasia, as the brain may be attempting to suppress potentially inefficient or maladaptive right hemisphere recruitment.

Overall, our findings suggest that aphasia type and severity may shape how the brain reorganizes after stroke. Understanding these distinctions may help tailor rehabilitation approaches by identifying which patterns of neural reorganization are adaptive for specific aphasia profiles. Future research is needed to understand how functional connectivity relates to different language functions.

References

- Gibson, M., Newman-Norlund, R., Bonilha, L. et al. (2024). The Aphasia Recovery Cohort, an open-source chronic stroke repository. *Sci Data* 11, 981. <https://doi.org/10.1038/s41597-024-03819-7>
- Labache, L., Joliot, M., Saracco, J. et al. (2019). A SENTence Supramodal Areas Atlas (SENSAAS) based on multiple task-induced activation mapping and graph analysis of intrinsic connectivity in 144 healthy right-handers. *Brain Structure and Function*, 224(2), 859–882. <https://doi.org/10.1007/s00429-018-1810-2>
- Zhu, H., Fitzhugh, M. C., Keator, L. M. et al. (2025). How Can Graph Theory Inform the Dual-stream Model of Speech Processing? A Resting-state Functional Magnetic Resonance Imaging Study of Stroke and Aphasia Symptomology. *Journal of Cognitive Neuroscience*, 37(3), 737–766. https://doi.org/10.1162/jocn_a_02278

Acknowledgments

This study used data from *The Aphasia Recovery Cohort*, an open-source chronic stroke repository (Gibson et al., 2024). We thank the participants, clinicians, and researchers who contributed to the creation and maintenance of this valuable resource.

Mapping of critical prosodic and phonetic networks in post-stroke apraxia of speech

G. Lynn Kurteff^{1*}, Grant M. Walker¹, Julius Fridriksson², and Gregory Hickok^{1,3}

¹ Cognitive Sciences, University of California, Irvine, CA, USA

² Communication Sciences and Disorders, University of South Carolina, Columbia, SC, USA

³ Language Science, University of California, Irvine, CA, USA

*corresponding author, lkurteff@uci.edu

Introduction

Since its initial description in the mid-20th century, post-stroke apraxia of speech (AOS) has been defined by what it is *not*, namely neither aphasia nor dysarthria (Darley, 1968). The last half-century was marked by attempts to better diagnose and/or classify AOS which resulted in a history of controversy surrounding the disorder; regardless, “neither aphasia nor dysarthria” persists as the diagnostic standard (Ziegler et al., 2012). Neuroimaging is a promising method to identify subtypes of AOS which could lead to better therapeutic outcomes for individuals with the disorder (Mailend & Maas, 2020). Evidence for this comes from primary progressive AOS (PPAOS), where strong evidence is building for *prosodic* and *phonetic* subtypes of the neurodegenerative disorder (Utianski et al., 2018). But, corroboration of these types in a stroke cohort is limited to one study with a small sample size (Takakura et al., 2019). A recent neurobiological model of speech coordination segregates the motor cortex into a dorsal aspect governing laryngeal control and prosody, and a ventral aspect governing supra-laryngeal control and articulation (Hickok et al., 2023). These dorsal/ventral precentral speech areas (dPCSA, vPCSA, respectively), combined with the identification of prosodic and phonetic subtypes in PPAOS, motivates the search for similar subtypes of AOS in stroke survivors.

Methods

Behavioral and imaging data from 127 individuals post left-hemisphere stroke (64 with AOS) were collected as part of the Center for the Study and Treatment of Aphasia Recovery (C-STAR) project (Spell et al., 2020). AOS severity was quantified via the Apraxia of Speech Rating Scale (ASRS; Strand et al., 2014). While later iterations of the ASRS explicitly separate out prosodic and phonetic ability (Duffy et al., 2023), these data were collected before these versions were available. 13 of the 16 ASRS items collected are present on the updated ASRS, facilitating grouping of scores into prosodic and phonetic subscores. To validate our dataset’s ability to capture these subscores, we employed an unsupervised clustering technique based on agglomerative clustering. Identified ASRS subscores were then used to predict lesion volume to specific regions of interest as parcellated by an anatomical atlas (e.g., AICHA; Joliot et al., 2015). The lesion-symptom mapping method we employed is a novel technique (Walker et al., in prep) for identifying critical regions that support the ability to predict a behavioral score while minimizing the issues of multiple comparison introduced by traditional voxelwise lesion-symptom mapping. First, candidate regions were identified through a *p* value calculated

via resampling methods. Next, permutations of these candidate regions were fit in bivariate models predicting behavior via in-network volume and out-of-network volume, with prediction accuracy evaluated via cross-validation. The set of candidate regions that minimizes the out-of-sample prediction error for a given behavioral score was dubbed the critical network for that behavioral score.

Results

To validate our dataset's ability to identify prosodic and phonetic elements of AOS, we fit an unsupervised clustering model on the original 16 ASRS scores and found that of the three primary clusters, two coincided with the delineation of ASRS scores into prosodic and phonetic subtests in more recent iterations of the scale (Figure 1A). Candidate regions (Figure 1B) were permuted into critical networks (Figure 1C) that best predicted within-cluster scores. In line with prior work in PPAOS, the "prosodic" network was located more focally in dorsal sensorimotor cortex near the dPCSA while the "phonetic" network was more distributed across premotor and sensorimotor cortex. Unlike in PPAOS, however, the "prosodic" network extended to the anterior insula and temporal pole and the "phonetic" network extended to posterior insula and temporoparietal junction. All three critical networks reduced prediction error relative to a univariate lesion volume model.

Conclusions

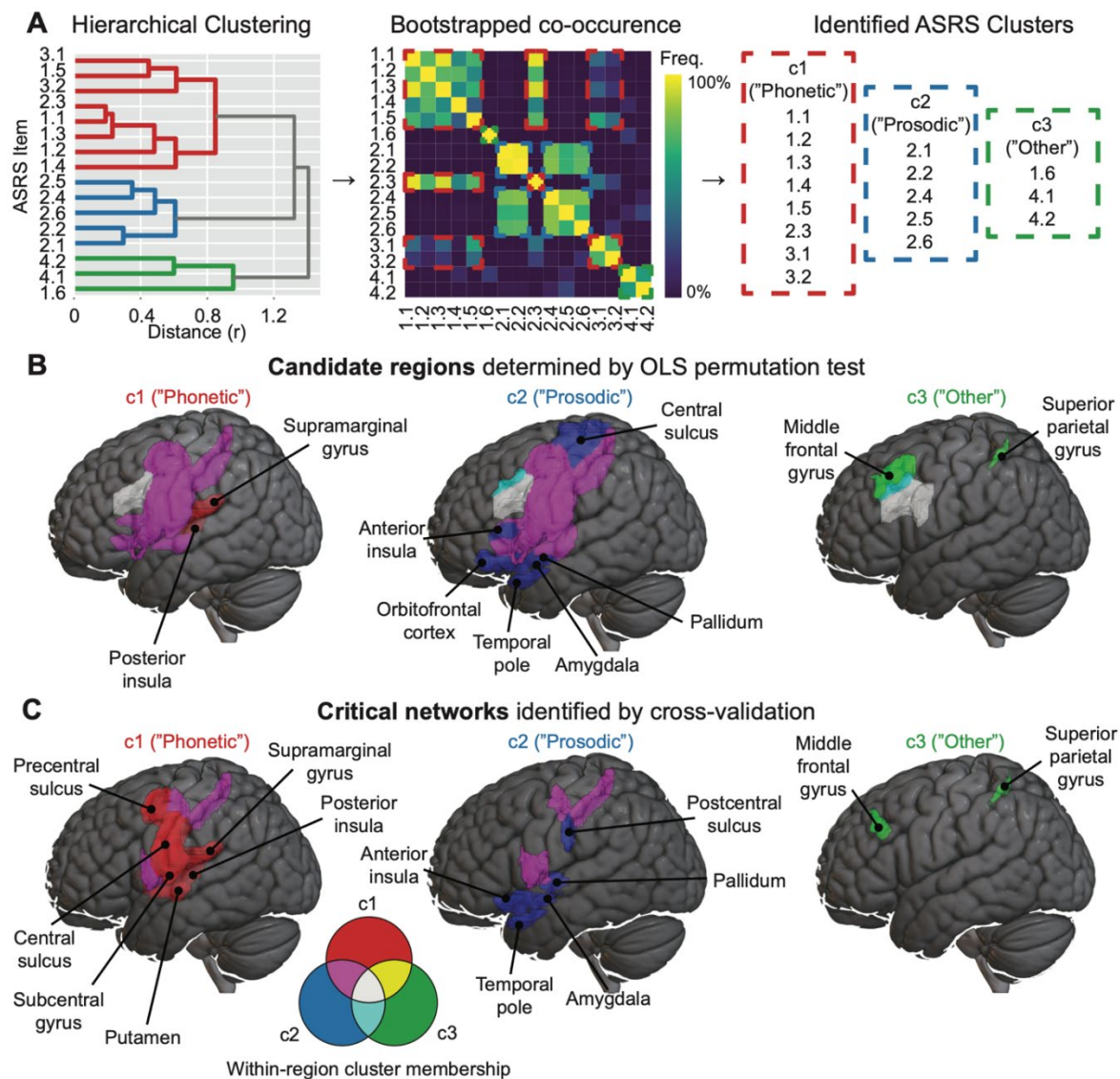
This work represents the first investigation into the neurobiology of prosodic and phonetic subtypes of post-stroke AOS in a large cohort of individuals. While some aspects of the identified critical network maps align with the neurodegenerative literature and theoretical models of motor coordination, namely the localization of prosody to dorsal precentral gyrus and a more ventral, distributed localization of articulation, several unexpected regions in temporal and insular cortex suggest there is more work needed to describe the brain regions supporting the faculties impaired in AOS. We hope this work motivates the development of assessment and treatment techniques individually targeting prosodic and phonetic functioning to better serve individuals with all subtypes of AOS and facilitate clinical discussion of the disorder.

References

- Darley, F. L. (1968). Apraxia speech: 107 years terminological confusion. *American Speech Hearing Association*.
- Duffy, J. R., Martin, P. R., Clark, H. M., Utianski, R. L., Strand, E. A., Whitwell, J. L., & Josephs, K. A. (2023). The apraxia of Speech Rating Scale: Reliability, validity, and utility. *American Journal of Speech-Language Pathology*, 32(2), 469–491.
- Hickok, G., Venezia, J., & Teghipco, A. (2023). Beyond Broca: neural architecture and evolution of a dual motor speech coordination system. *Brain: A Journal of Neurology*, 146(5), 1775–1790.
- Joliot, M., Jobard, G., Naveau, M., Delcroix, N., Petit, L., Zago, L., Crivello, F., Mellet, E., Mazoyer, B., & Tzourio-Mazoyer, N. (2015). AICHA: An atlas of intrinsic connectivity of homotopic areas. *Journal of Neuroscience Methods*, 254, 46–59.
- Mailend, M.-L., & Maas, E. (2020). To lump or to split? Possible subtypes of apraxia of speech. *Aphasiology*, 35(4), 592–613.

- Spell, L. A., Richardson, J. D., Basilakos, A., Stark, B. C., Teklehaimanot, A., Hillis, A. E., & Fridriksson, J. (2020). Developing, implementing, and improving assessment and treatment fidelity in clinical aphasia research. *American Journal of Speech-Language Pathology*, 29(1), 286–298.
- Strand, E. A., Duffy, J. R., Clark, H. M., & Josephs, K. (2014). The Apraxia of Speech Rating Scale: a tool for diagnosis and description of apraxia of speech. *Journal of Communication Disorders*, 51, 43–50.
- Takakura, Y., Otsuki, M., Sakai, S., Tajima, Y., Mito, Y., Ogata, A., Koshimizu, S., Yoshino, M., Uemori, G., Takakura, S., & Nakagawa, Y. (2019). Subclassification of apraxia of speech in patients with cerebrovascular and neurodegenerative diseases. *Brain and Cognition*, 130, 1–10.
- Utianski, R. L., Duffy, J. R., Clark, H. M., Strand, E. A., Botha, H., Schwarz, C. G., Machulda, M. M., Senjem, M. L., Spykalla, A. J., Jack, C. R., Jr, Petersen, R. C., Lowe, V. J., Whitwell, J. L., & Josephs, K. A. (2018). Prosodic and phonetic subtypes of primary progressive apraxia of speech. *Brain and Language*, 184, 54–65.
- Ziegler, W., Aichert, I., & Staiger, A. (2012). Apraxia of speech: concepts and controversies. *Journal of Speech, Language, and Hearing Research: JSLHR*, 55(5), S1485-501.

Figure 1. Unsupervised clustering of AOS subtypes via critical region lesion-symptom mapping.
A: Left: Dendrogram of correlation distance between individual items on the ASRS. Middle: Confusion matrix showing frequency of within-branch co-occurrence of ASRS items as calculated by bootstrapping (2000 permutations). Three clusters are outlined in red, green, and blue dashed lines. Right: Individual ASRS items cluster into three categories as visible in the dendrogram and confusion matrix. c1 and c2 correspond roughly with the phonetic (red) and prosodic (blue) subscores specified in the most recent version of the ASRS. **B:** Candidate networks of AICHA atlas regions supporting the clusters of (A). Regions are color-coded according to their identity within the three clusters; for example: a purple-colored region was identified as a candidate region in clusters c1 & c2 while a red-colored region was only identified as a candidate region in c1. Candidate regions unique to one cluster (i.e., red, blue, or green) are individually labeled. **C:** Critical networks of AICHA regions for the clusters of (A). The critical network is the subset of candidate regions that minimize prediction error during cross-validation. Regions are colored and labeled similarly to (B).



Idiom Comprehension in Alzheimer's Disease – A Systematic Review

**Anastasia Lada*¹, Silke Coemans¹, Philippe Paquier^{1,2,3}, Christina Manouilidou⁴,
Ifigeneia Dosi⁵ and Stefanie Keulen¹**

¹ Brussels Centre for Language Studies, Vrije Universiteit Brussel, Brussels, Belgium

² Faculté de Psychologie, Université Libre de Bruxelles, Brussels, Belgium

³ Department of Translational Neurosciences, Universiteit Antwerpen, Antwerp, Belgium

⁴ Department of Comparative and General Linguistics, University of Ljubljana, Ljubljana, Slovenia

⁵ Department of Greek Philology, Democritus University of Thrace, Komotini, Greece

***Anastasia Lada, Anastasia.Lada@vub.be**

Introduction

Idioms are expressions whose meaning cannot be deduced solely from their constituent words. Their linguistic complexity influences brain processing (Papagno & Cacciari, 2005; Papagno, 2010). Idiom comprehension might rely on executive functions (EFs), requiring the activation of literal and figurative meanings and inhibiting literal interpretations to access figurative ones. However, it is unclear whether all idioms varying in their linguistic properties (familiarity, frequency, decomposability, transparency, and predictability) rely equally on EFs.

Alzheimer's disease (AD), a neurodegenerative condition affecting memory and cognition (Wray, 2011), presents with memory disturbances, word-finding issues, and impaired executive functions. AD patients struggle to inhibit automatically activated literal meanings, suggesting idiom comprehension may be impaired. Understanding how idioms are impaired in AD can help assess cognitive decline linked to memory and/or EFs.

This review investigates: (a) whether idiom comprehension is impaired in AD and tied to idiom properties, (b) how task selection affects performance, and (c) EF-idiom comprehension links in AD.

Methods

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines (PRISMA). We searched Scopus, PubMed, and Science Direct (through May 2025). Of 11 included studies, we extracted data on idiom properties, task paradigms, EF/language/cognitive measures, and comprehension accuracy.

Results

Most studies (10/11) assessed idiom properties, but none measured decomposability or predictability. Only two studies test different types of idioms varying in their internal dimensions, and none examines their interaction. Next, the most prevalent tasks across studies were the string-to-picture matching task, the string-to-word matching task, and oral definitions. While EF/language assessments were sparse (inhibition: 4 studies; shifting: 2; verbal fluency: 4; memory via the Token Test: 3), most studies evaluated global cognition (MMSE, MODA, GDS). All studies included mild to moderate AD except for one

in which the disease severity ranged from mild to severe AD. Last, only 3 studies found intact idiom comprehension in AD.

Conclusions

Findings suggest idiom dimensions modulate comprehension in AD. Three studies showed that opaque idioms were generally better preserved, irrespective of the idioms' degree of ambiguity. However, the rest of the studies found impaired comprehension, especially for transparent idioms, irrespective of the idioms' ambiguity. However, several studies showed that ambiguity posed even more challenges. In addition, the results showed that task choice significantly affected comprehension, with string-to-picture matching tasks potentially overestimating deficits.

Lastly, information about patients' EFs and memory performance is inadequate to draw firm conclusions. However, based on the current data, we assume that EFs and memory retrieval in idiom comprehension operate on a continuum. Ambiguous and decomposable idioms might demand more EF involvement for resolving ambiguity and semantic links, while unambiguous, opaque idioms may rely more on mental lexicon retrieval. Last, tailoring tasks to patients' cognitive abilities is crucial to accurately assess idiom comprehension in AD. Future studies should standardize idiom assessments, controlling for idiom characteristics, task demands, but also different patient characteristics like the severity of the disease, to provide a clearer picture of idiom comprehension patterns in AD.

References

- Papagno, C., & Cacciari, C. (2005). Ambiguous idioms understanding in Italian aphasic patients. In *Proceedings of the Cognitive Science Society*.
- Papagno, C. (2010). Idiomatic language comprehension: Neuropsychological evidence. In *Neuropsychology of communication* (pp. 111-129). Milano: Springer Milan.
- Wray, A. (2011). Formulaic language as a barrier to effective communication with people with Alzheimer's disease. *Canadian Modern Language Review*, 67(4), 429-458.

Retrieval Facilitates Retention: Long-Term Effects of Implicit Structural Priming Treatment in Aphasia

Jiyeon Lee¹, Catherine T. Pham¹, Peng Zhang¹, Victor Ferreira², Nadine Martin³, Katelin M. Rainey¹, Emily Bauman¹, and Sein Min¹

¹ Department of Speech, Language, and Hearing Sciences, Purdue University, West Lafayette, IN, USA

² Department of Psychology, University of California at San Diego, San Diego, CA, USA

³ Department of Communication Sciences and Disorders, Temple University, Philadelphia, PA, USA

*corresponding author, lee1704@purdue.edu

Introduction

Structural priming, an individual's tendency to reuse recently processed syntactic structures (Bock, 1986), offers a promising approach for treating syntactic deficits in persons with aphasia (PWA), leveraging implicit learning to strengthen mapping of syntactic information. Recent work shows structural priming treatment effectively improves sentence production in PWA (Lee et al., 2025), but how syntactic information is reinforced during treatment may be as critical as the sentence structures themselves. Retrieval practice of information has been shown to strengthen long-term retention more effectively than passive review (Karpicke & Roediger, 2008). This retrieval-based learning advantage has been observed in word learning in aphasia (Schuchard & Middleton, 2018), but its role in syntactic re-learning remains underexplored. We investigated whether retrieval practice of syntactic forms during structural priming yields greater gains than simply reading them and whether gains generalize beyond trained items.

Methods

Data collection is ongoing, but thus far 18 PWA and 13 controls have completed two treatment phases, each targeting passive or double object dative sentences. Each phase included baseline testing, three training sessions involving retrieval practice or re-study of the prime sentence, and immediate (1-day) and delayed (1-week) post-testing. During training, participants engaged in oral structural priming using a read-aloud paradigm (Bock & Griffin, 2000; Lee & Man, 2017). The key manipulation was whether participants attempted to actively generate the prime's syntactic structure (retrieval condition) or heard and read aloud the prime sentence (reading condition), while keeping the number of opportunities for encoding prime sentences equal. The order of target sentences and training conditions were counterbalanced across participants. At baseline and post-testing, sentence production and completion probes were administered to assess improvement and maintenance of trained and untrained target sentences.

Results

In sentence production, both PWA and controls showed significant gains from baseline to immediate and delayed post-testing across conditions ($z_s > 5.05$, $ps < .001$). For controls, reading primes yielded greater gains at both post-tests ($z_s = -2.35$, $ps < .05$).

PWA showed comparable performance across training conditions at immediate post-testing ($z = 1.62$, $p = .90$) but greater improvement following retrieval practice at delayed post-testing ($z = 2.64$, $p < .01$). In sentence completion, controls performed at ceiling. PWA improved from baseline to immediate and delayed post-testing ($z_s > 2.81$, $p_s < .01$). While gains were comparable across training conditions at immediate post ($z = 1.09$, $p = .89$), PWA exhibited greater improvement following retrieval practice at delayed post-testing ($z = 3.00$, $p < .01$). Training effects also generalized to untrained stimuli. In both tasks, PWA showed significant gains from baseline to post-testing on trained and untrained items ($z_s > 4.55$, $p_s < .01$), though gains were larger for trained items ($z_s > 3.44$, $p_s < .03$).

Conclusions

These findings demonstrate that structural priming treatment can yield measurable gains in sentence production in PWA. Unlike controls, PWA benefited more from retrieval-based training, which supported greater long-term retention. Importantly, gains extended to untrained items. These results highlight the potential of retrieval-based approaches to enhance treatment durability and support language recovery.

References

- Bock, K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, 18(3), 355–387.
- Bock, K., & Griffin, Z. M. (2000). The persistence of structural priming: Transient activation or implicit learning. *Journal of Experimental Psychology: General*, 129(2), 177–192.
- Karpicke, J. D., & Roediger, H. L. (2008). The critical importance of retrieval for learning. *Science (New York, N.Y.)*, 319(5865), 966–968.
- Lee, J., & Man, G. (2017). Language recovery in aphasia following implicit structural priming training: A case study. *Aphasiology*, 31(12), 1441–1458.
- Lee, J., van Boxtel, W. S., Weirick, J. D., Ferreira, V., Martin, N., Bauman, E. L., Haven, L. N., Sayers, M. J., & Manning, R. G. C. (2025). Implicit structural priming as a treatment component for aphasia: Specifying essential learning conditions. *Cognitive Neuropsychology*, 0(0), 1–25.
- Schuchard, J., & Middleton, E. L. (2018). The Roles of Retrieval Practice Versus Errorless Learning in Strengthening Lexical Access in Aphasia. *Journal of Speech, Language, and Hearing Research*, 61(7), 1700–1717.

Acknowledgments

This work was supported by NIH R01DC019129.

Linguistic tools for the early diagnosis of dementia: a systematic review

Julia Leira¹, Isabel González-Abraldes¹, Nuria Cibeira¹, Ana Maseda¹ and Silvia Martínez Ferreiro^{1,2*}

¹ Gerontology and Geriatrics Research Group, Instituto de Investigación Biomédica de A Coruña (INIBIC), Complejo Hospitalario Universitario de A Coruña (CHUAC), SERGAS, Universidade da Coruña, A Coruña, Spain

² Department of Psychology, Faculty of Education Sciences, Universidade da Coruña, A Coruña, Spain

***corresponding author, s.martinez.ferreiro@udc.es**

Introduction

The global increase in life expectancy has raised the prevalence of cognitive decline and dementia. Dementia is projected to affect 152 million people by 2050 (WHO, 2024). Language disorders are key clinical features of dementia and mild cognitive impairment (MCI), often emerging early (Ahmed et al., 2013; Taler & Phillips, 2008). As dementia progresses, language abilities further deteriorate. This is why early and subtle changes can serve as warning signs of significant neurological decline (Alsheikhidris, 2024). Designing and adapting appropriate language assessment tools is essential for guiding interventions, supporting communication, and assisting in differential diagnosis. This presentation aims to identify and analyze effective protocols for detecting language disorders across dementia stages.

Methods

A systematic review following PRISMA (2020) guidelines was conducted from November to December. A total of 2,770 articles were identified from the following databases: Web of Science, Medline, and Scopus. The Joanna Briggs Institute (JBI) critical appraisal tool was used to ensure methodological rigor and assess study quality.

Seventeen studies met the predefined eligibility criteria: they included language assessment protocols incorporating more than one task and linguistic domain, thus allowing for a comprehensive evaluation of language performance. Studies involving participants aged 60 years or younger were excluded in order to focus specifically on populations with a higher risk of dementia and age-related language impairment.

Results

The seventeen studies in this review, conducted across Europe, Asia, North and South America, evaluated linguistic tools for the detection of cognitive impairment in older adults across diverse clinical and community-based settings. In total, 2,724 individuals participated in the above-mentioned studies, including healthy controls and individuals diagnosed with MCI or some form of dementia.

Most studies used verbal fluency, naming, and comprehension tasks, often in conjunction with standardized assessments such as the Boston Naming Test (BNT), NeuroBel, Severe Impairment Battery Language scale (SIB-L), Token Test, and a range of language

specific evaluations. These included both classic language tasks and newly developed tools tailored to specific populations and linguistic backgrounds.

Findings indicate that the tools explored are sensitive in identifying language impairments associated with MCI, Alzheimer's Disease (AD), and Progressive Primary Aphasia (PPA), even in early stages of disease progression. Instruments such as NeuroBel, the Mini Linguistic State Examination (MLSE), and the Litmus SRT demonstrated high diagnostic validity and reliability in differentiating between clinical groups.

Additionally, executive fluency tasks proved useful in individuals with subjective cognitive complaints, offering a sensitive measure for early detection. Moreover, remote assessment via telemedicine was shown to be a viable alternative to face-to-face evaluation, with comparable diagnostic outcomes, highlighting its potential for wider clinical application in cognitively vulnerable populations.

Conclusions

Using specialized language assessment protocols is key for the early detection of neurodegenerative disorders. These protocols are essential for identifying early signs of cognitive decline. By providing valuable insights into language impairments, they help guide personalized treatment strategies that can slow the progression of deterioration and focus on preserving functional communication skills, making the selection of properly standardized culturally-inclusive language tests of the utmost importance.

References

- Ahmed, S., Haigh, A.M., de Jager, C.A., & Garrard, P. (2013). Connected speech as a marker of disease progression in autopsy-proven Alzheimer's disease. *Brain*, 136(12), 3727–3737. <https://doi.org/10.1093/brain/awt269>
- Alsheikhidris, M. A. A. (2024). Linguistic markers of neurodegenerative disorders: Implications for early diagnosis and intervention. *Journal of Health and Medical Sciences*, 7(4), 23–35. <https://doi.org/10.31014/aior.1994.07.04.326>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
- Taler, V., & Phillips, N.A. (2008). Language performance in Alzheimer's disease and mild cognitive impairment: A comparative review. *Journal of Clinical and Experimental Neuropsychology*, 30(5), 501–556. <https://doi.org/10.1080/13803390701550128>
- World Health Organization. (2024). Ageing and health. World Health Organization. Retrieved May 12, 2025, from <https://www.who.int/es/news-room/fact-sheets/detail/ageing-and-health>

Acknowledgments

JLM, AM, IGA, NC, & SMF acknowledge support of of ED431F 2024/018, Xunta de Galicia, Spain. SMF also acknowledges support of RYC2020-028927-1, MICIU/AEI /10.13039/501100011033 y por El FSE invierte en tu futuro.

Linguistic Diversity in Neurodevelopment: Investigating the Role of Bilingualism on Post-Stroke Cognitive and Linguistic Outcomes

**Kai Ian Leung^{1,2*}, Robyn Westmacott³, Nomazulu Dlamini⁴, Elizabeth Rochon^{1,2},
Monika Molnar^{1,2}**

¹ Rehabilitation Sciences Institute, University of Toronto, Toronto, ON, Canada

² Speech-Language Pathology, University of Toronto, Toronto, ON, Canada

³ Department of Psychology, Hospital for Sick Children, Toronto, ON, Canada

⁴ Division of Neurology, Hospital for Sick Children, Toronto, ON, Canada

***corresponding author, kaiian.leung@mail.utoronto.ca**

Introduction

Pediatric stroke occurs during a sensitive period of neurodevelopment, often leading to lasting neurocognitive impacts. While the pediatric brain is highly plastic—making it both vulnerable and adaptable—outcomes vary. Research in neurotypical children suggests bilingualism enhances executive function and metalinguistic skills due to the constant management of two language systems (Bialystok & Craik, 2010). In adult populations, bilingualism has been linked to delayed onset of Alzheimer's disease symptoms, suggesting a role in cognitive reserve (Craik et al., 2010). Building upon these findings, our prior retrospective study found bilingualism to positively influence post-stroke language, challenging older assumptions that bilingualism might hinder rehabilitation (Leung et al., 2023). Given that nearly half of the global population is bilingual (Grosjean, 2010), advancing our understanding of bilingual development is essential. This study investigates the impact of bilingual exposure on cognitive and linguistic outcomes in children following arterial ischemic stroke. We hypothesize that bilingual children will perform as well as or better than monolingual peers in post-stroke assessments of language and executive function, suggesting a protective rather than detrimental effect.

Methods

This single-site, cross-sectional study involves 56 arterial ischemic stroke patients aged 0-18 years. Data was prospectively collected through medical records, caregiver questionnaires detailing language exposure and socioeconomic status and standardized assessments evaluating language and executive function. We considered key variables such as sociodemographic factors (e.g., socioeconomic status), linguistic exposure (e.g., age of bilingual acquisition, quantity), and neurological factors (e.g., age at stroke) in relation to neurocognitive development. Multivariate analyses will be used to discern the relationships between bilingual exposure and neurocognitive outcomes, controlling potential confounders.

Results

Preliminary analyses suggest that bilingual children may exhibit advantages in specific domains of executive function and language skills post-stroke. However, these advantages were not uniform across all domains, suggesting that the benefits of

bilingualism post-stroke may be domain-specific and influenced by other moderating variables, such as age at stroke or quantity of language exposure. These findings align with theories positing that bilingualism enhances cognitive control mechanisms, which may facilitate development in certain neurocognitive domains. Ongoing data collection will further clarify these patterns.

Conclusions

Preliminary findings suggest that bilingualism does not impede and may facilitate neurodevelopment in specific cognitive and linguistic domains following injury. Given that bilingual children may follow diverse post-stroke trajectories, it is critical that research and clinical discussions reflect this diversity to ensure equitable access to appropriate support. Challenging misconceptions that bilingualism is a barrier to development and learning, this research advocates culturally and linguistically responsive practices in healthcare and education that affirm the strengths of bilingual children rather than viewing their linguistic diversity as a hindrance.

References

- Bialystok, E., & Craik, F. I. (2010). Cognitive and linguistic processing in the bilingual mind. *Current directions in psychological science*, 19(1), 19-23.
- Craik, F. I., Bialystok, E., & Freedman, M. (2010). Delaying the onset of Alzheimer disease: Bilingualism as a form of cognitive reserve. *Neurology*, 75(19), 1726-1729.
- Grosjean, F. (2010). Myths about bilingualism. *Myths about Bilingualism*.
- Leung, K. I., Dlamini, N., Westmacott, R., & Molnar, M. (2023). Language and Cognitive Outcomes Following Ischemic Stroke in Children With Monolingual and Bilingual Exposure. *Journal of Child Neurology*, 38(6–7).

Acknowledgments

We gratefully acknowledge the following funding sources: the Peterborough K.M. Hunter Graduate Student Award (KIL), the Hilda and William Courtney Clayton Paediatric Research Fund (KIL), the Theresa and Miron Polatajko Graduate Award (KIL), and the NSERC Discovery Grant (MM).

The Relationship between Non-language Cognitive Function and Brain Networks Changes in Post Stroke Aphasia Patients

Siqi Li¹, Yumei Zhang^{2*}

¹ Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

² Department of Rehabilitation Medicine, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

***corresponding author, zhangyumei95@aliyun.com**

Introduction

Post-stroke aphasia (PSA) is characterized by acquired language impairment caused by acute cerebrovascular disease. The presence of language production and/or auditory comprehension abilities might mask the impairment of their non-language cognitive function, which ultimately affect social interactions. However, the current standardization level in diagnostic procedures of cognitive function assessment is low, and the underlying neural mechanisms of non-language cognitive impairment remain unclear. Thus, this study aimed to evaluate non-language cognitive performance and the relationship with functional abnormalities of brain networks in PSA patients.

Methods

We recruited 46 PSA patients and 40 normal controls (NCs) matched for general characteristics in this study, who underwent cognitive tests and functional magnetic resonance imaging (fMRI). Generally, aphasia was diagnosed by the Western Aphasia Battery (WAB). Non-language cognitive function were evaluated by the Loewenstein Occupational Therapy Cognitive Assessment (LOTCA). Independent component analysis was carried out to identify resting-state networks (RSNs) and to investigate functional connections (FC) between different RSNs. Independent component analysis was carried out to identify RSNs. Two-sample t-tests were used to calculate WAB, LOTCA scores and inter-network FC differences between different groups. The results were corrected for multiple comparisons using the false discovery rate (FDR correction, $p < 0.05$). Pearson correlation analyses were performed to observe the relationship between FC and cognitive performance in PSA patients.

Results

This study showed the LOTCA total score was significantly lower in PSA patients than in NCs ($p < 0.001$). Nine meaningful RSNs were identified, including auditory network (AUN), visual network (VIS), right and left executive control network (rECN, lECN), dorsal and ventral default mode network (dDMN, vDMN), language network (LN), sensorimotor network (SMN) and salience network (SAN). For inter-network FC analysis, compared to NCs, PSA patients showed a significantly increased coupling between rECN-AUN, DMN, LN; vDMN-AUN, LN; LN-AUN; SMN-SAN. While the FCs between bilateral ECNs and lECN-DMN, LN, VIS decreased (FDR correction, $p < 0.05$). Furthermore, the heat maps of the correlation matrix showed that alterations in these inter-network FCs of PSA

patients were correlated with decline in non-language cognitive measurements. It is specifically manifested as: PSA patients showed a significant positive correlation between the altered FCs of bilateral ECNs and thinking operation. Patients also displayed a significant negative correlation between the altered FCs of rECN-AUN and LOTCA total score. Moreover, both altered FCs of rECN-dDMN and rECN-LN were negatively associated with spatial perception ability.

Conclusions

PSA patients have more extensive and severe non-language cognitive impairment. Altered FCs were revealed between multiple RSNs in PSA patients at the subacute stage. IECN as the core of brain networks disconnection phenomenon was the key element participating in cognitive destruction. The enhanced connections between brain networks with rECN as the core suggested compensatory recombination. Moreover, Changes in in FCs between different RSNs in PSA patients were associated with impaired non-language cognition. These findings suggested that brain injury may affect cognitive abilities by altering functional connections between regions, and abnormal patterns of functional connections (reorganization of language and cognitive networks) may contribute to good functional remodeling.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (grant number. 81972144, 82372555). We appreciate all the staff and participants of this study for their contribution.

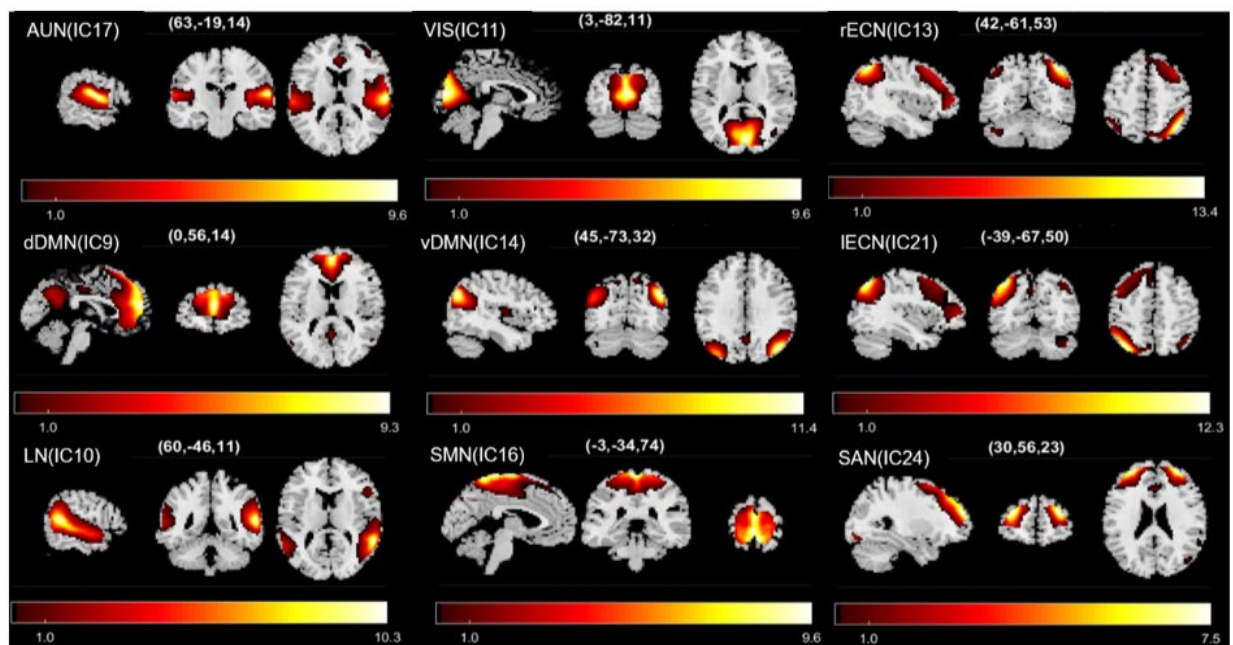


Figure 1. Nine meaningful RSNs identified via independent component analysis

Table 1. Comparison of clinical characteristics, WAB and LOTCA scores of PSA patients and NCs

	PSA	NCs	<i>P</i>
Gender (male/female)	32/14	24/16	0.131
Age (years)	53.41±12.47	48.79±12.87	0.110
Education (years)	10.83±4.24	11.85±2.69	0.190
NIHSS at admission, median (IQR)	3.00(1.00-5.00)	-	-
WAB			<0.001
AQ	46.60±23.26	100.00±00.00	<0.001
Spontaneous speech	9.13±4.66	20.00±00.00	<0.001
Comprehension	136.00±62.46	200.00±00.00	<0.001
Repetition	48.48±32.26	100.00±00.00	<0.001
Naming	37.63±30.19	100.00±00.00	<0.001
LOTCA			
Total score	69.46±18.51	102.74±4.65	<0.001
Orientation	9.52±4.90	15.00±0.78	<0.001
VP	13.17±2.75	14.47±1.35	0.007
SP	6.24±2.96	11.44±0.50	<0.001
MP	9.00±2.89	11.38±0.49	<0.001
VMO	16.96±5.05	24.50±1.42	<0.001
TO	14.54±6.39	25.94±1.41	<0.001
Attention	2.87±0.81	3.53±0.51	<0.001

Data are mean±standard deviation (range).

PSA, post-stroke aphasia. NC, normal control. WAB, Western Aphasia Battery. AQ, aphasia quotient. LOTCA, Loewenstein Occupational Therapy Cognitive Assessment. VP, visual perception. SP, spatial perception. MP, motor praxis. VMO, visuomotor organization. TO, thinking operation.

Using Semantic Networking Strategies, Habit Formation, and Prompt Fading to Improve Anomia for Aphasic Individuals

Mei-Hua Li^{1*}, Lauryn Zipse¹, Esther Herring¹, Anthony Pak-Hin Kong², and Sofia Vallila-Rohter¹

¹ Communication Science Department, MGH Institute of Health Professions, Boston, MA, U.S.A.

² Faculty of Education, The University of Hong Kong, Hong Kong, China

*corresponding author, mli13@mghihp.edu

Introduction

Anomia, difficulty with word finding, poses a communication challenge for people with aphasia (PWAs) and their communicative partners. Semantic feature analysis (SFA) is a frequently studied treatment approach that is thought to strengthen the connections between words and semantic relations and improve word retrieval. Additionally, SFA can potentially compensate for communication breakdowns by improving circumlocution or talking around a word that is beneficial to communication partners. The literature has demonstrated that restitution and substitutive strategies can be effective in improving word-finding with PWAs (Cavanaugh et al., 2022; Tilton-Bolowsky et al., 2023). However, one of the major limitations of SFA is that generalization to untrained targets is limited and studies often focus only on PWAs with mild to moderate language deficits.

Aim. The purpose of this experiment was to examine the efficacy of an abridged semantic feature analysis protocol, focusing on three-feature questions (e.g., attributes, functions, and personal association) trained through habit formation and prompt fading, implemented through telepractice. This protocol was designed to be accessible to people with moderate to severe aphasia and to facilitate the internalization (learning) of the SFA framework to promote application in real-world contexts.

Methods

Five participants were enrolled in the study. Sessions were carried out twice a week over Zoom. Participants were enrolled for eight weeks or until they reached 80% accuracy on two consecutive probes. The experimenters utilized a single-subject multiple baseline design evaluating naming ability across four categories of common everyday items (e.g., kitchen items, tools and hardware). All participants completed a pre- and post-treatment battery that evaluated naming ability as well as aphasia type and severity, cognitive ability, and semantic ability. Personalized training lists were selected for each participant based on three pre-treatment naming baseline measurements. Targets named incorrectly on at least two out of three baselines became teaching targets. Each participant was trained on eight to fifteen items in therapy. Weekly probes examining trained items (T), untrained, semantically related items (Un-Sem), and untrained unrelated items (Un-Un) were completed. Lists of T, Un-Sem, and Un-Un were balanced on word frequency and length. A simplified SFA framework was utilized, focusing on three feature questions. SFA prompts (e.g., visual scaffold, written, and pictorial cues) were systematically faded as participants demonstrated internalization of the framework.

Results

Data were collected on pre- and post-treatment naming accuracy and feature naming and naming response time. Probe data were collected weekly during treatment to evaluate progress on trained and untrained items. Preliminary results suggested that the modified SFA framework taught through habit formation and prompt fading improves naming of trained items post-training. Participants further showed a decreased dependence on clinician-provided prompts when practicing the SFA framework and generating features. Analyses of response time, untrained item accuracy, and feature generation are ongoing.

Conclusion

Preliminary results indicate that this protocol improved word retrieval and led to framework learning. Findings further add to the literature by demonstrating improvements in word retrieval for a range of moderate and severe subtypes of people with aphasia and apraxia.

References

- Boyle, M. (2010). Semantic feature analysis treatment for aphasic word retrieval impairments: What's in a name? *Topics in Stroke Rehabilitation*, 17(6), 411–422. <https://doi.org/10.1310/tsr1706-411>
- Cavanaugh, R., Quique, Y. M., Dickey, M. W., Hula, W. D., Boss, E., & Evans, W. S. (2022). Practice-related predictors of semantic feature verification treatment for aphasia. *American Journal of Speech-Language Pathology*, 31(5S), 2366–2377. https://doi.org/10.1044/2021_AJSLP-21-00296
- Conroy, P., Sage, K., & Lambon Ralph, M. A. (2009). The effects of decreasing and increasing cue therapy on improving naming speed and accuracy for verbs and nouns in aphasia. *Aphasiology*, 23(6), 707–730. <https://doi.org/10.1080/02687030802165574>
- Evans, W. S., Cavanaugh, R., Gravier, M. L., Autenreith, A. M., Doyle, P. J., Hula, W. D., & Dickey, M. W. (2021a). Effects of semantic feature type, diversity, and quantity on semantic feature analysis treatment outcomes in aphasia. *American Journal of Speech-Language Pathology*, 30(1S), 344–358.
- Evans, W. S., Cavanaugh, R., Quique, Y., Boss, E., Starns, J. J., & Hula, W. D. (2021b). Playing with BEARS: Balancing effort, accuracy, and response speed in a semantic feature verification anomia treatment game. *Journal of Speech, Language & Hearing Research*, 64(8), 3100–3126. https://doi.org/10.1044/2021_JSLHR-20-00543
- Gilmore, N., Meier, E. L., Johnson, J. P., & Kiran, S. (2020). Typicality-based semantic treatment for anomia results in multiple levels of generalisation. *Neuropsychological Rehabilitation*, 30(5), 802–828. <https://doi.org/10.1080/09602011.2018.1499533>
- Gravier, M. L., Dickey, M. W., Hula, W. D., Evans, W. S., Owens, R. L., Winans-Mitrik, R. L., & Doyle, P. J. (2018). What matters in semantic feature analysis: Practice-related predictors of treatment response in aphasia. *American Journal of Speech-Language Pathology*, 27(1S), 438–453. https://doi.org/10.1044/2017_AJSLP-16-0196

- Kiran, S., & Thompson, C. K. (2003). The role of semantic complexity in treatment of naming deficits: Training semantic categories in fluent aphasia by controlling exemplar typicality. *Journal of Speech, Language, and Hearing Research*, 46(4), 773–787. [https://doi.org/10.1044/1092-4388\(2003/061\)](https://doi.org/10.1044/1092-4388(2003/061))
- Kiran, S., & Bassetto, G. (2008). Evaluating the effectiveness of semantic-based treatment for naming deficits in aphasia: what works? *Seminars in Speech and Language*, 29(1), 71–82. <https://doi.org/10.1055/s-2008-1061626>
- Nunn, K., Vallila-Rohter, S., & Middleton, E. L. (2023). Errorless, errorful, and retrieval practice for naming treatment in aphasia: A scoping review of learning mechanism and treatment ingredients. *Journal of Speech, Language, and Hearing Research*, 66(2), 668–687. https://doi.org/10.1044/2022_JSLHR-22-00251
- Quique, Y. M., Evans, W. S., & Dickey, M. W. (2019). Acquisition and generalization responses in aphasia naming treatment: A meta-analysis of semantic feature analysis outcomes. *American Journal of Speech-Language Pathology*, 28(1S), 230–246. https://doi.org/10.1044/2018_AJSLP-17-0155
- Smith, K. S., & Graybiel, A. M. (2016). Habit formation. *Dialogues in Clinical Neuroscience*, 18(1), 33–43. <https://doi.org/10.31887/DCNS.2016.18.1/ksmith>
- Tilton-Bolowsky, V. E., Brock, L., Nunn, K., Evans, W. S., & Vallila-Rohter, S. (2023). Incorporating metacognitive strategy training into semantic treatment promotes restitutive and substitutive gains in naming: A single-subject investigation. *American Journal of Speech-Language Pathology*, 32(5), 1979–2020. https://doi.org/10.1044/2023_AJSLP-22-00230

Acknowledgments

The authors acknowledge the Christopher Norman Education Fund for sponsoring this study.

Figure 1. P3 Results

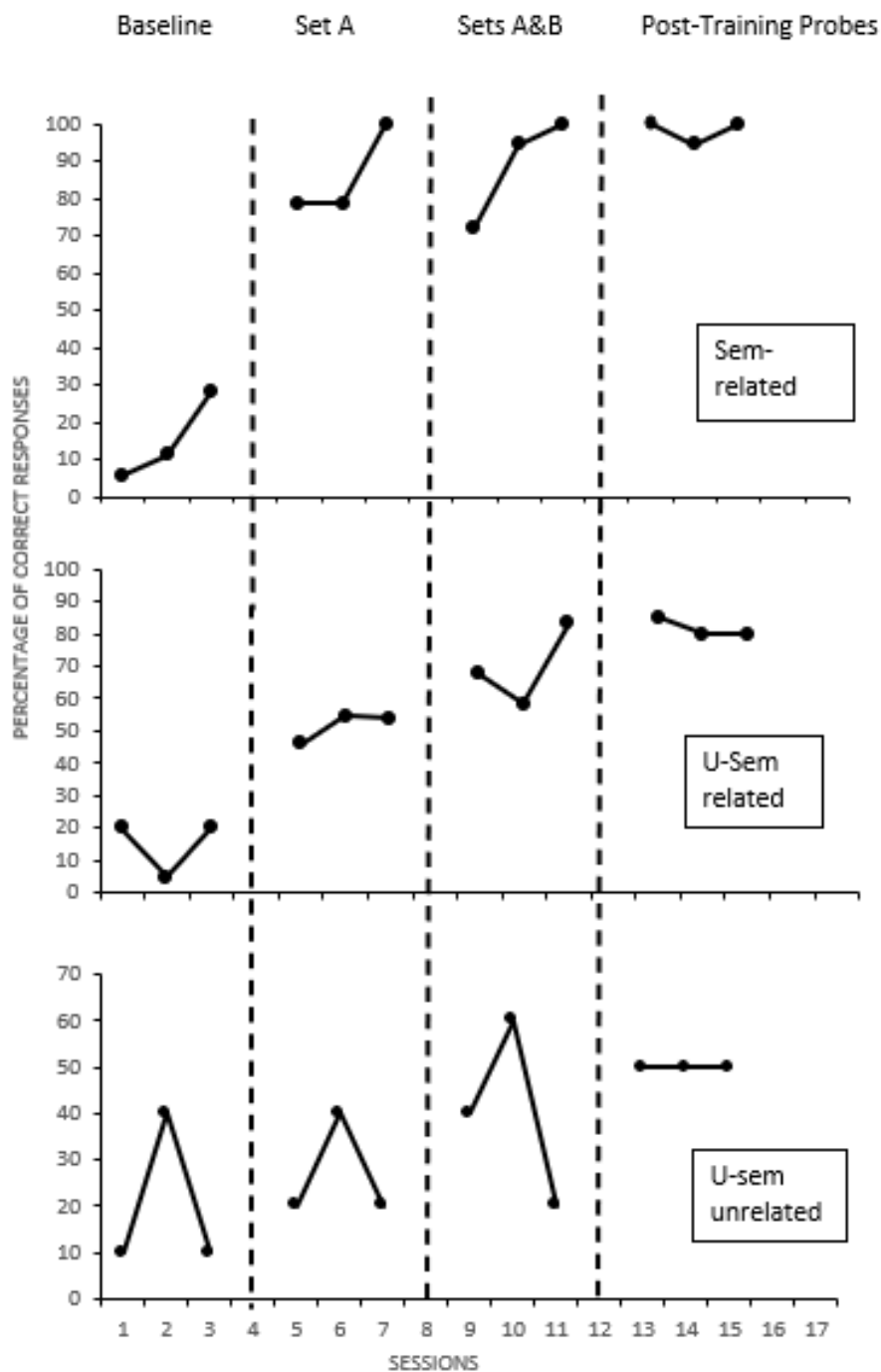


Figure 1. This is a multiple baseline across behaviors experimental design with the percentage of correct responses using a modified SFA, habit formation, and prompt fading for P3. Baseline and post-training probes consisted of 48 targets, and weekly probes consisted of an average of 33 targets.

Neuropathological fingerprints of language in primary progressive aphasia - revisited

Michelle Anne Los^{1*}, Jane Kathleen Stocks¹, Tamar Gefen^{1,2}, Changiz Geula^{1,3}, Elena Barbieri^{1,4}, M.-Marsel Mesulam^{1,5}, and Sandra Weintraub^{1,2}

¹ Mesulam Center for Cognitive Neurology and Alzheimer's Disease, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

² Department of Psychiatry and Behavioral Sciences, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

³ Department of Cell and Developmental Biology, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

⁴ Department of Physical Medicine and Rehabilitation, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

⁵ Department of Neurology, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

*Corresponding author, michelle.los@northwestern.edu

Introduction

Primary progressive aphasia (PPA) is a clinical syndrome characterized by a gradual decline in language abilities over one to two years, occurring in relative isolation before other cognitive and behavioral domains are affected (Mesulam et al, 2012). On autopsy, brains of individuals with PPA may display a variety of neurodegenerative diseases, whose concordance with the three major clinical variants is probabilistic at best (Mesulam et al., 2022). Among the neurodegenerative diseases at the root of PPA, Alzheimer's disease (AD) is the only one for which *in vivo* biomarkers (e.g., PET scans) are available, a fact that poses major limitations to the early prediction of the neuropathology underlying PPA. While prior studies have suggested associations between language performance on standardized tests and underlying neuropathology (Mesulam et al., 2022), they have not considered measures derived from the analysis of spontaneous speech. In this study we aim to fill this gap by studying the relationship between impairment in selected language domains (e.g., lexical-semantics, morpho-syntax) – based on both standardized text and spontaneous speech - and autopsy-confirmed neuropathologic diagnosis in PPA.

Methods

Data from 93 participants with PPA and confirmed postmortem diagnoses were analyzed. Standardized aphasia assessment of lexical-semantics, repetition, and syntax were available for all. For 73 of these participants, there were additional measures of lexical-semantics, morphology, syntax, and fluency derived from a narrative speech task (the retelling of the Cinderella story). Of the 93 cases, 44 had a neuropathologic diagnosis of AD, 21 of TDP-43 proteinopathy (TDP-C), 9 of Pick's Disease (PiD), and 19 of 4R tauopathy (Progressive Supranuclear Palsy, PSP, n=8, or Corticobasal Degeneration, CBD, n=11). Linear mixed-effects regression was used to investigate between group differences.

Results

Measures of lexical-semantic and syntax derived from standardized assessments distinguished TDP-C from all other groups. Naming had the greatest discriminative power between neuropathologies. Repetition accuracy distinguished AD pathology from TDP-C, Pick's, and PSP but not CBD. While no standardized tests differentiated between the two 4R tauopathies (CBD vs. PSP), a narrative morphology measure (% correct irregular verb inflections) significantly differentiated between them. Fluency, as measured by words per minute in the narrative task, clearly distinguished TDP-C from all other neuropathologies, with the TDP-C group significantly more fluent than other groups in this task (Thompson, 2012).

Conclusions

Standardized assessments, particularly of lexical-semantics, continue to be a valuable clinical tool in not only diagnosing the clinical subtypes of PPA but also in distinguishing amongst different neuropathologies. But narrative language measures provide more nuanced information about morphological and syntactic abilities that, in combination with information about fluency, may discriminate between CBD and PSP (Thompson, 2012). Together, these findings suggest a combination of standardized aphasia tests and measures derived from narrative speech can improve prediction of underlying neuropathologic disease in PPA.

References

- Mesulam, M. M., Coventry, C. A., Bigio, E. H., Sridhar, J., Gill, N., Fought, A. J., ... & Rogalski, E. J. (2022). Neuropathological fingerprints of survival, atrophy and language in primary progressive aphasia. *Brain*, 145(6), 2133-2148.
- Mesulam, M. M., Wieneke, C., Thompson, C., Rogalski, E., & Weintraub, S. (2012). Quantitative classification of primary progressive aphasia at early and mild impairment stages. *Brain*, 135(5), 1537-1553.
- Thompson, C. K., Cho, S., Hsu, C. J., Wieneke, C., Rademaker, A., Weitner, B. B., ... & Weintraub, S. (2012). Dissociations between fluency and agrammatism in primary progressive aphasia. *Aphasiology*, 26(1), 20-43.

Acknowledgments

Cynthia K. Thompson, PhD and Jennifer Mack, PhD, Northwestern University Aphasia and Neurolinguistics Research Laboratory
National Institute on Deafness and Other Communication Disorders, DC008552
National Institute of Neurological Disorders and Stroke, NS075075
National Institute on Aging, AG13854, R01 AG056258, R01 AG055425, R01 AG077444
IDPH, Alzheimer's Association, AFTD

Figure 1. Naming demonstrated the greatest discriminatory power between neuropathologies

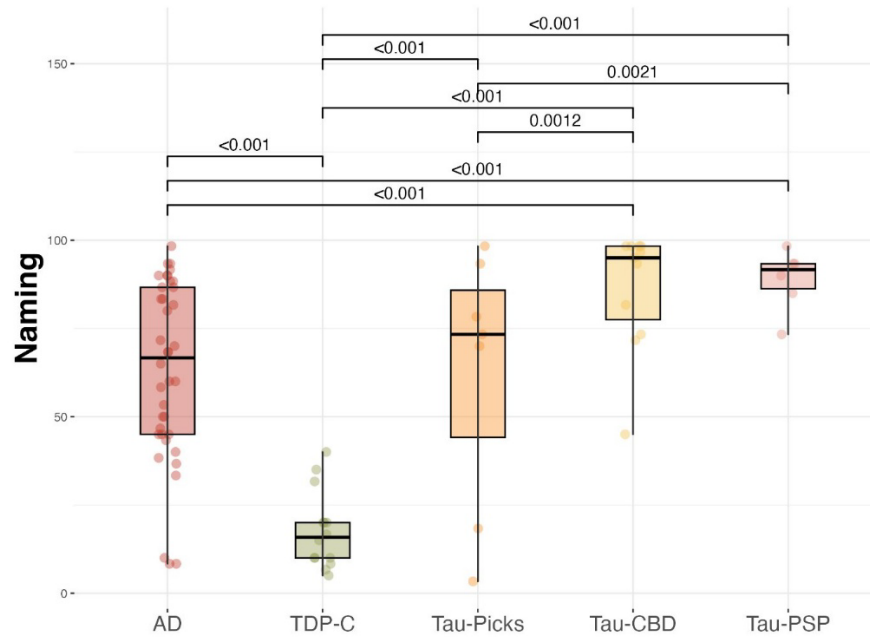


Table 1. Participant demographics

Characteristic	Overall N = 76 ¹	AD N = 38 ¹	TDP-C N = 14 ¹	Tau-Picks N = 7 ¹	Tau-CBD N = 11 ¹	Tau-PSP N = 6 ¹	p-value ²
Clinical Subtype							
Agrammatic	34	15	0	5	8	6	
Logopenic	17	15	0	0	2	0	
Semantic	13	0	12	1	0	0	
Mixed/Other	12	8	2	1	1	0	
Age at Visit	65.1 (7.2)	65.8 (6.9)	61.2 (6.4)	61.6 (3.2)	66.2 (8.2)	71.7 (6.9)	0.015
Age at Onset	60.9 (7.5)	61.3 (7.3)	57.0 (6.3)	57.9 (3.8)	62.5 (8.7)	68.7 (7.4)	0.024
Age at Death	72.0 (7.1)	72.1 (6.9)	70.1 (5.7)	68.3 (3.4)	73.6 (9.4)	76.8 (8.3)	0.11
Disease Duration	11.1 (3.8)	10.9 (4.2)	13.1 (2.7)	10.4 (3.2)	11.1 (4.0)	8.2 (1.7)	0.003
Sex							0.8
F	35	15	8	3	6	3	
M	41	23	6	4	5	3	
Education	15.8 (2.5)	16.4 (2.3)	14.6 (2.8)	15.9 (2.9)	15.9 (2.2)	14.3 (1.5)	0.080
WAB AQ	84.2 (9.0)	84.7 (8.6)	82.5 (12.5)	81.2 (6.7)	84.5 (7.1)	88.4 (8.5)	0.6
CDR Global (Initial)	0.3 (0.3)	0.3 (0.2)	0.3 (0.3)	0.4 (0.3)	0.2 (0.3)	0.3 (0.3)	0.7
ADL-Q (Initial)	17.6 (13.2)	17.3 (10.0)	17.2 (10.4)	28.7 (29.5)	12.4 (9.4)	16.9 (11.6)	0.5

¹ n; Mean (SD)

² One-way analysis of means (not assuming equal variances); Fisher's exact test

A Mindfulness-based Intervention for Improving Mental Health and Loneliness in People with Aphasia

Sandy J. Lwi^{1*}, Janell Flores Bolte¹, Janet Patterson¹, and Juliana V. Baldo^{1,2}

¹Research Service, VA Northern California Health Care System, Martinez, CA, USA

²Department of Neurology, University of California, Davis, CA, USA

***corresponding author, sandy.lwi@va.gov**

Introduction: Every year, over 200,000 Americans develop stroke-related aphasia (National Aphasia Association, 2024). Aphasia often leads to declines in mood, as nearly 20% of people with aphasia (PWA) report depression (Ashaie et al., 2019) and 40% of PWA report anxiety (Morris et al., 2017). Another predictor of distress in PWA is loneliness (Hilari et al., 2010), which many PWA experience due to communication challenges and changes in their ability to engage in jobs and hobbies, all of which significantly reduce their opportunities to maintain social relationships (Azios et al., 2022; Nyström, 2006). Unfortunately, little research has focused on identifying effective strategies to address loneliness and mental health in PWA, in part because PWA are typically excluded from clinical and research interventions (Shiggins et al., 2023). We have begun to address this gap by adapting a mindfulness-based intervention (MBI) to make it accessible to PWA, with work in progress focused on examining both its feasibility and preliminary efficacy for improving mental health and loneliness in PWA.

Methods: Based on our prior work with stroke survivors, some of whom had mild aphasia (Baldo et al., 2021), we designed an 8-week MBI for PWA. The course was adapted from a traditional Mindfulness Based Stress Reduction protocol (Kabat-Zinn, 1990) and designed to be taught online in order to maximize participation of PWA with mobility/transportation challenges. The intervention, led by a trained and certified MBSR instructor, focuses on teaching three main mindfulness skills: orienting, breath, and body scan (one skill a week, followed by a week of reinforcing the skill), with the final sessions focused on integrating the practices. The MBI sessions have been adapted for PWA in several ways: shortening the class to 1.5 hours, using aphasia-specific communication strategies such as short and simple sentences, frequent instructor check-ins during the class to verify understanding, employing closed captioning during sessions, and encouraging PWA to ask questions (Rautakoski, 2011). We also developed original audio and video content to support MBI sessions, which include closed captioning and visual illustrations for accessibility. Ten PWA will complete the MBI, and questionnaires and post-intervention interviews will be conducted to assess feasibility and efficacy.

Results: Data collection will be complete in the fall, and descriptive statistics will be presented for feasibility measures (e.g., recruitment and retention rates) and efficacy measures (e.g., loneliness, depression, and anxiety). Participants' feedback will also be used to evaluate the efficacy of the intervention and highlight areas of improvement for future clinical trials.

Conclusions: This pilot study will evaluate the feasibility of an online MBI designed specifically to address loneliness and mental health in PWA. Mindfulness is an ideal intervention for PWA because it focuses on behavioral skills that do not require overt speech. This can offer respite from the struggle PWA may experience with interventions that require extensive levels of speaking, allowing PWA to instead focus on improving their social and mental health. We hope this study will lead to larger clinical trials of MBIs to address loneliness and mental health changes in PWA.

References

- Ashaie, S. A., Hurwitz, R., & Cherney, L. R. (2019). Depression and subthreshold depression in stroke-related aphasia. *Archives of Physical Medicine and Rehabilitation*, 100(7), 1294–1299.
- Azios, J. H., Strong, K. A., Archer, B., Douglas, N. F., Simmons-Mackie, N., & Worrall, L. (2022). Friendship matters: A research agenda for aphasia. *Aphasiology*, 36(3), 317–336.
- Baldo, J. V., Schendel, K., Lwi, S. J., Herron, T. J., Dempsey, D. G., Muir, J., Curran, B. C., Paulraj, S., Chok, J., & Cole, M. A. (2021). Mindfulness-Based Stress Reduction Intervention in Chronic Stroke: a Randomized, Controlled Pilot Study. *Mindfulness*, 1–12.
- Hilari, K., Northcott, S., Roy, P., Marshall, J., Wiggins, R. D., Chataway, J., & Ames, D. (2010). Psychological distress after stroke and aphasia: the first six months. *Clinical Rehabilitation*, 24(2), 181–190.
- Kabat-Zinn, J. (1990). *Full catastrophe living: The program of the stress reduction clinic at the University of Massachusetts Medical Center*. Delacorte Press.
- Morris, R., Eccles, A., Ryan, B., & Kneebone, I. I. (2017). Prevalence of anxiety in people with aphasia after stroke. *Aphasiology*, 31(12), 1410–1415.
- National Aphasia Association. (2024). *Aphasia Fact Sheet*. <https://aphasia.org/aphasia-resources/aphasia-factsheet/>
- Nyström, M. (2006). Aphasia—an existential loneliness: A study on the loss of the world of symbols. *International Journal of Qualitative Studies on Health and Well-Being*, 1(1), 38–49.
- Rautakoski, P. (2011). Training total communication. *Aphasiology*, 25(3), 344–365.
- Shiggins, C., Ryan, B., Dewan, F., Bernhardt, J., O'Halloran, R., Power, E., Lindley, R. I., McGurk, G., & Rose, M. L. (2023). Inclusion of people with aphasia in stroke trials: a systematic search and review. *Archives of Physical Medicine and Rehabilitation*, 105, 580–592.

Acknowledgments

We would like to thank the National Academy of Aphasia for providing Dr. Lwi with the Barbara Martin Aphasia Grant that made this pilot study possible, as well as our Veterans with aphasia for participating in the study and providing feedback.

Eliciting Naturalistic, Experimentally Controlled Sentence Recordings from People with Aphasia: A Pilot Study

Jennifer E. Mack^{1*}, Angela Murzin¹, and Madeline Peck¹

¹ Department of Speech, Language, and Hearing Sciences, University of Massachusetts Amherst, Amherst, MA, USA

*corresponding author, jemack@umass.edu

Introduction

Communication partners (CPs) often fail to fully understand people with aphasia (PWA). Improving CPs' comprehension skills would increase communication success for PWA. To do this, it is important to characterize (and ultimately, enhance) key language processes that support CPs' comprehension of PWA. Experimental techniques such as eye-tracking can be used to measure CPs' language processes as they listen to language recordings made by PWA (e.g., Ward & Mack, 2022). These language recordings should be naturalistic, so that they provide a close approximation to real-life communication. However, they must also be experimentally controlled, i.e., share key linguistic features, to allow aggregation of CPs' processing data across trials. This pilot study evaluated a new protocol through which we aimed to elicit naturalistic, experimentally controlled sentence recordings from people with mild-moderate aphasia. Because PWA often struggle to convey their messages to service workers (Anglade et al., 2021), we elicited recordings of service requests (i.e., requests for goods, services, or information; Felix-Brasdefer, 2015).

Methods

One person with chronic post-stroke aphasia participated. P01 is a 63-year-old white man and a monolingual English speaker. He has mild, anomic aphasia (overall score of 8.05 on the Quick Aphasia Battery (QAB); Wilson et al., 2018). P01 indicated that he is "somewhat effective" when asking for information from store employees (Aphasia Communication Outcome Measure; Hula et al., 2015).

P01 made audio recordings of 182 unique service requests in a sound booth. For each recording, P01 envisioned himself in a service interaction and expressed a realistic request in his own words. Multimodal language support (pictures, auditory and written prompts) was provided (Figure 1). To encourage natural language production, no corrective feedback was given.

To evaluate naturalness, we analyzed the recordings' (1) pragmatic features (service request type, politeness markers); (2) speech/language features in comparison to P01's connected speech scores from the QAB. To evaluate experimental control, we computed the percentage of recordings that were suitable for use in our eye-tracking experiments probing CPs' language processes.

Results

The recordings included several naturally occurring pragmatic types of service requests and 14.8% included politeness markers (e.g., *please*). The most common

speech/language feature in the recordings was self-correction, which was also prominent in P01's connected speech (Table 1). With respect to experimental control, 93.4% of recordings were suitable for the planned eye-tracking experiments (i.e., they contained fluent, accurate production of 1-2 key words).

Conclusions

The protocol elicited naturalistic, experimentally controlled recordings from one speaker with mild, anomic aphasia. Pragmatically, the recordings were varied and included features of real-life service requests (e.g., politeness markers). Additionally, the recordings generally reflected P01's connected speech patterns. However, anomia was less evident in the recordings than in connected speech, likely because the multimodal recording prompts supported word retrieval. Conversely, phonemic paraphasias were not present in connected speech but occurred occasionally in the recordings, mainly during production of phonologically complex noun phrases (e.g., *green frying pan*). Further research will test the protocol's effectiveness in speakers with aphasia of different types and severity levels.

References

- Anglade, C., Le Dorze, G., & Croteau, C. (2021). How clerks understand the requests of people living with aphasia in service encounters. *Clinical Linguistics and Phonetics*, 35(1), 84-99.
- Felix-Brasdefer, J. C. (2015). *The Language of Service Encounters: A Pragmatic-Discursive Approach*. Cambridge University Press.
- Hula, W. D., Doyle, P. J., Stone, C. A., Austermann Hula, S. N., Kellough, S., Wambaugh, J. L., Ross, K. B., Schumacher, J. G., & St. Jacques, A. (2015). The Aphasia Communication Outcome Measure (ACOM): Dimensionality, item bank calibration, and initial validation. *Journal of Speech, Language, and Hearing Research*, 58(3), 906-919.
- Ward, C. B., & Mack, J. E. (2022). The effect of an aphasia ID card on processing of language produced by a speaker with nonfluent aphasia. *Journal of Communication Disorders*, 100, 1-14.
- Wilson, S. M., Eriksson, D. K., Schneck, S. M., & Lucanie, J. M. (2018). A quick aphasia battery for efficient, reliable, and multidimensional assessment of language function. *PLoS One*, 13(2), e0192773.

Acknowledgments

This research was funded by the US National Institutes of Health (R21 DC021233; PI: Mack). Cristina Arrondo, Gwennyth Carter, Elizabeth Laughlin, Michelle Letowska, and Sumayah Mohamed contributed to the development of the stimuli and Nina Blanche to analysis of the recordings. Jane Sackett assisted with scoring the Quick Aphasia Battery, and Matthew Walenski consulted on data analysis.

Figure 1. Sample Prompt Used to Elicit a Service Request Recording. This prompt elicited the recording “*Can I ... where are the towels please?*”

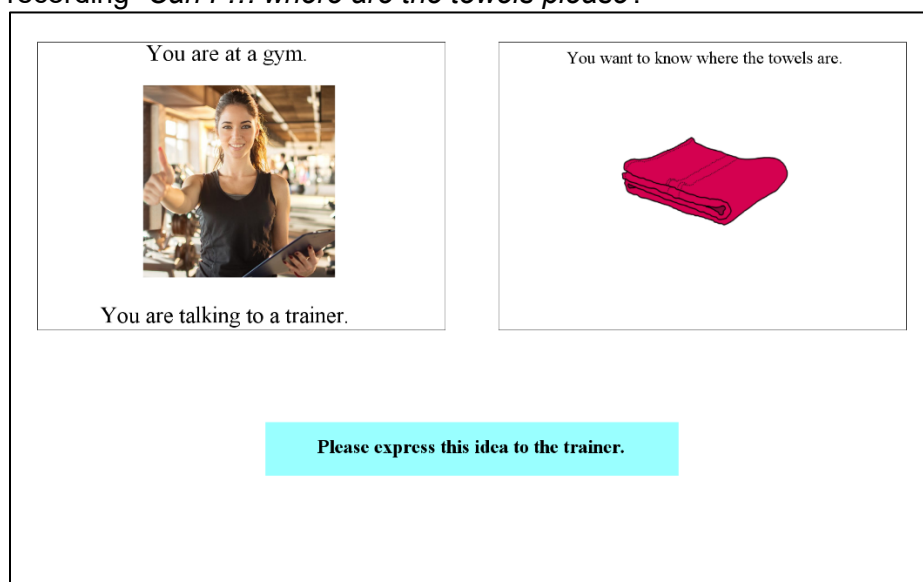


Table 1. P01’s Connected Speech Features on the Quick Aphasia Battery and in the Service Request Recordings. MLU = mean length of utterance; WPM = words per minute; SD = standard deviation.

Connected Speech Feature	Quick Aphasia Battery Connected Speech Rating	Service Request Recordings
Reduced length and complexity of utterances	3 [MLU 5-7 words]	MLU = 6.5; SD = 1.7
Reduced speech rate	3 [75-99 WPM]	Mean WPM = 94.1; SD = 23.5
Agrammatism	3 [mild: detectable but infrequent]	1.7% of recordings
Paragrammatism	3 [mild: detectable but infrequent]	2.2% of recordings
Anomia	2 [moderate: frequent but not pervasive]	4.9% of recordings
Empty speech	3 [mild: detectable but infrequent]	0.0% of recordings
Semantic paraphasias	3 [mild: detectable but infrequent]	1.1% of recordings
Phonemic paraphasias and neologisms	4 [normal: not present or within normal range]	5.5% of recordings
Self-correction	2 [moderate: frequent but not pervasive]	14.3% of recordings

Recent Developments in AphasiaBank

Brian MacWhinney¹ and Davida Fromm¹

¹ Psychology, Carnegie Mellon University, Pittsburgh, PA, USA

*corresponding author, macw@cmu.edu

Introduction

AphasiaBank provides data and training materials to thousands of members of the research and clinical community internationally. Increases in computing power and infrastructure are leading to major improvements in AphasiaBank resources which will be described in this poster.

Methods

As one of the 14 components of TalkBank, AphasiaBank seeks to advance Open Science by following these basic principles:

1. Data in AphasiaBank focus on recordings of spoken language. The contexts include teletesting sessions, in person interviews, group therapy sessions, and personal narratives.
2. Data has been contributed by scores of researchers working in hospitals, universities, clinics, life participation centers, and over the web.
3. Participants provide informed consent for inclusion of their recordings over the web with password protection.
4. Much of the data has been and is being collected using a standard protocol that allows for comparison across corpora.
5. All recordings are transcribed in a common format, called CHAT and linked on the utterance and sometimes word level to the media (audio or video)
6. The linked transcripts with media can be played back directly through the TalkBank browser (after authentication) or downloaded to the desktop for later playback.
7. In general, AphasiaBank seeks to maximize the accessibility and quality of data to support Open Science.

To promote the ability of researchers and clinicians to make maximal use of AphasiaBank data, we have developed these methods:

1. **TalkBankDB** is a searchable database with built in graphics and ways of sending data to Excel, R, and Python for further analysis.
2. **Grand Rounds** provides analyses of sessions with people representing different types of aphasia.
3. **Examples** provides playable recordings exemplifying 24 phenomena in aphasia.
4. **CLAN** provides a series of programs for analysis and profiling of PWAs, including main concept analysis, core lexicon, lexical diversity, grammatical complexity and many other measure, all provided with comparisons to the fuller database for detailed assessment and evaluation.
5. **Collaborative Commentary** allows for group analysis of transcripts in AphasiaBank over the web. The group leader can create a series of tags for

aspects of interaction and language in aphasia which are then used by group members to comment upon and tag interactions. This method is being widely used by instructors who give this as a class assignment, but also by research groups such as groups analyzing gesture in aphasia

6. **Batchalign** is a Python pipeline for automatic speech recognition that produces output in CHAT format for inclusion in the database. It also automates morphosyntactic analysis, transcript-media alignment, benchmark evaluation of ASR, and addition of translations.
7. **WebBA** allows users to upload media to a server at CMU for automatic analysis through Batchalign.

Results

This paper will provide examples of the use of each of the new methods listed above.

Conclusions

AphasiaBank is providing a crucial resource for the study of aphasia.

Acknowledgments

The development of AphasiaBank has been supported by NID

Interbrain Synchrony as a Potential Biomarker of Communicative Success in Aphasia: Preliminary Evidence from fNIRS Hyperscanning

Grace Magee¹, James Colwell¹, Joseph Licata¹, Shannon Kelley¹, Berk Tellioglu², David Boas^{1,3}, Swathi Kiran^{2,4}, Maria Varkanitsa^{2,4}, Erin Meier⁵, & Meryem Yücel^{1,3*}

¹ Department of Biomedical Engineering, Boston University, Boston, MA

² Center for Brain Recovery, Boston University, Boston, MA

³ Neurophotonics Center, Boston University, Boston, MA

⁴ Department of Speech, Language, and Hearing Sciences, Boston University, Boston, MA

⁵ Department of Communication Sciences and Disorders, Northeastern University, Boston, MA

***Meryem Yücel, mayucel@bu.edu**

Introduction

Communication is a two-way process, yet aphasia research often neglects interaction dynamics between people with aphasia (PWA) and their communication partners. Hyperscanning research indicates that greater communicative success coincides with greater interbrain synchrony (IBS) in the prefrontal cortex (PFC) and temporoparietal junction (TPJ) between healthy dyads (Czeszumski et al., 2022; Kelsen et al., 2020) and that IBS varies with intersubject interactivity and familiarity/closeness (De Felice et al., 2025). To assess whether IBS is a biomarker of communicative success, we examined IBS across language tasks with different levels of interaction and alignment in dyads including healthy adults and a PWA.

Methods

In Experiment 1, 32 young adults (16 dyads) completed four tasks that varied in expected alignment and coupling: Independent Reading of passages (low/spurious coupling), Joint Reading of passages (entrainment-based coupling), Joint Singing (entrainment-based coupling), and Picture Guess, involving partners taking turns asking questions/guessing depicted objects on the other's cards (semantic alignment-based coupling). Each task contained two 120-sec blocks interleaved with 30-sec rest. In Experiment 2, one individual with anomic aphasia completed the same tasks with a familiar, trained speech-language pathologist (dyad 1) and a non-clinician stranger (dyad 2). fNIRS data were collected from 16 sources and 16 detectors per cap arranged over bilateral inferior and middle frontal gyri (IFG/MFG), dorsolateral (dl) PFC, TPJ, and supramarginal gyrus (SMG). Standard preprocessing steps were followed in Homer3 (Huppert et al., 2009). IBS was determined by computing wavelet coherence (R^2 values) (Cui et al., 2012) between homologous brain regions per dyad.

Results

In Experiment 1, Joint Singing IBS was significantly greater than Joint Reading IBS in bilateral MFG ($p < 0.01$) and TPJ ($p < 0.01$) and Picture Guess IBS in bilateral MFG ($p < 0.05$), dlPFC ($p < 0.001$), and TPJ ($p < 0.001$). Bilateral SMG IBS was greater during

Picture Guess than Joint Reading ($p < 0.01$). IBS in IFG did not vary by task ($p > 0.05$). In Experiment 2, IBS increased from block 1 to block 2 across most tasks and regions for dyad 1 but decreased over time for dyad 2. Overall, across both blocks IBS tended to be lower across regions for the entire time series for dyad 1 than dyad 2 for Joint Singing, Joint Reading, and Picture Guess, but the opposite trend was observed for Independent Reading.

Conclusions

IBS was greatest between young adults in prefrontal regions and TPJ for Joint Singing, a task that stimulated entrainment but also capitalized on stimulus familiarity and melody to promote alignment. Opposite trends in increasing/decreasing IBS across interactive tasks for the PWA/clinician versus PWA/stranger dyads may be due to dyadic differences in leader/follower dynamics (Jiang et al., 2015). In dyad 1, the clinician acted as follower, modifying his speech rate/style to match the patient's with increasing behavioral alignment over time. In contrast, in dyad 2, the PWA acted as follower, trying to (unsuccessfully) keep up with the stranger (leader) who did not modify his speech rate/style, perhaps resulting in increasing disconnect over time. If replicated across additional dyads involving PWA, these findings have important implications for both aphasia care and two-person neuroscience.

References

- Cui, X., Bryant, D. M., & Reiss, A. L. (2012). NIRS-based hyperscanning reveals increased interpersonal coherence in superior frontal cortex during cooperation. *NeuroImage*, 59(3), 2430–2437. <https://doi.org/10.1016/j.neuroimage.2011.09.003>
- Czeszumski, A., Liang, S. H. Y., Dikker, S., et al. (2022). Cooperative behavior evokes interbrain synchrony in the prefrontal and temporoparietal cortex: A systematic review and meta-analysis of fNIRS hyperscanning studies. *eNeuro*, 9(2), ENEURO.0268-21.2022. <https://doi.org/10.1523/ENEURO.0268-21.2022>
- De Felice, S., Chand, T., Croy, I., et al. (2025). Relational neuroscience: Insights from hyperscanning research. *Neuroscience & Biobehavioral Reviews*, 169, 105979. <https://doi.org/10.1016/j.neubiorev.2024.105979>
- Huppert, T. J., Diamond, S. G., Franceschini, M. A., & Boas, D. A. (2009). HomER: A review of time-series analysis methods for near-infrared spectroscopy of the brain. *Applied Optics*, 48(10), D280–D298. <https://doi.org/10.1364/ao.48.00d280>
- Jiang, J., Chen, C., Dai, B., et al. (2015). Leader emergence through interpersonal neural synchronization. *Proceedings of the National Academy of Sciences of the United States of America*, 112(14), 4274–4279. <https://doi.org/10.1073/pnas.1422930112>
- Kelsen, B. A., Sumich, A., Kasabov, N., Liang, S. H. Y., & Wang, G. Y. (2022). What has social neuroscience learned from hyperscanning studies of spoken communication? A systematic review. *Neuroscience and Biobehavioral Reviews*, 132, 1249–1262. <https://doi.org/10.1016/j.neubiorev.2020.09.008>

Acknowledgments

This work was supported by the BRAIN initiative through NIH/NIBIB U01EB029856 awarded to Dr. David A. Boas and Dr. Swathi Kiran

Speech entrainment practice in aphasia: Efficacy and optimal training parameters

Marja-Liisa Mailend^{1,2*}, Shauna Zodrow¹, Laurel Buxbaum¹ and Erica Middleton¹

¹ Jefferson Moss Rehabilitation Research Institute, Thomas Jefferson University, Philadelphia, PA, USA

² Department of Special Education and Speech Therapy, University of Tartu, Tartu, Estonia

*corresponding author, marja-liisa.mailend@jefferson.edu

Introduction

Speech entrainment, speaking in unison with an auditory or audiovisual model, is a component in several well-known treatment approaches in aphasia rehabilitation [e.g., 1-3]. Recent studies [4;5] have renewed the interest in this technique by showing that speech entrainment itself can powerfully improve connected speech output in people with aphasia, even when independent speech is severely limited. The increase in speech output during entrainment is well-documented. What remains poorly understood is whether entrainment itself can enhance speech at a later point in time when the entrainment support is absent (i.e., independent speech). In addition, little is known about what entrainment training conditions and schedules might affect treatment efficacy. Thus, this project aims to experimentally delineate whether speech entrainment practice confers improved independent speech and identify conditions that provide maximal treatment benefits.

Methods

Eighteen participants with chronic aphasia from stroke participated. Each participant exhibited some characteristics of disrupted fluency. The experiment consisted of a single-session treatment, where ten short stories were practiced with an entrainment model for ten times. Independent speech was evaluated prior to and 24h following treatment. Treatment schedule was manipulated within each treatment session with half or the stories presented in a block of ten consecutive repetitions of the same story and the other half were distributed throughout the treatment session. In addition, treatment modality (auditory vs audiovisual entrainment) was manipulated. Additional ten stories were probed but untrained to control for the effect of repeated probing. Number of correct information units [6] served as the primary outcome.

Results

The effect of speech entrainment on independent speech 24 hours post-treatment was evaluated with a linear mixed effects model including Treatment (trained vs untrained stories), Phase (pre- vs post-treatment scores), and Treatment by Phase interaction as fixed effects. By-item and by-participant intercepts were entered as random effects. The model identified a significant effect of Phase ($t=5.44$, $p<.01$) and, critically, a significant Treatment by Phase interaction ($t=-2.14$, $p<.05$), indicating that pre-post treatment gains were larger for trained compared to untrained stories. Optimal treatment conditions were examined in separate linear mixed effects models with the same random structure as

above. Modality (Audio vs Audiovisual) or Schedule (Blocked vs Distributed) were entered as fixed effects. Both models included also the Phase and condition by Phase interaction as fixed effects. While Phase was significant for both models ($t=4.67$, $p<.01$ and $t=2.35$, $p<.05$ in models with Schedule and Modality respectively), neither of the examined conditions or their interaction with Phase were significant.

Conclusions

These initial findings demonstrated that speech entrainment (with both auditory and audiovisual entrainment model) is a potent active ingredient for boosting independent speech production in people with chronic aphasia with gains maintained 24h post-treatment. The lack of significant differences between the studied treatment conditions may suggest that entrainment practice can be individualized within these parameters based on a client's preference and what is feasible for treatment delivery. Future clinical trials are needed to examine the efficacy of speech entrainment practice administered at a larger scale, with a focus on assessing long-term benefits.

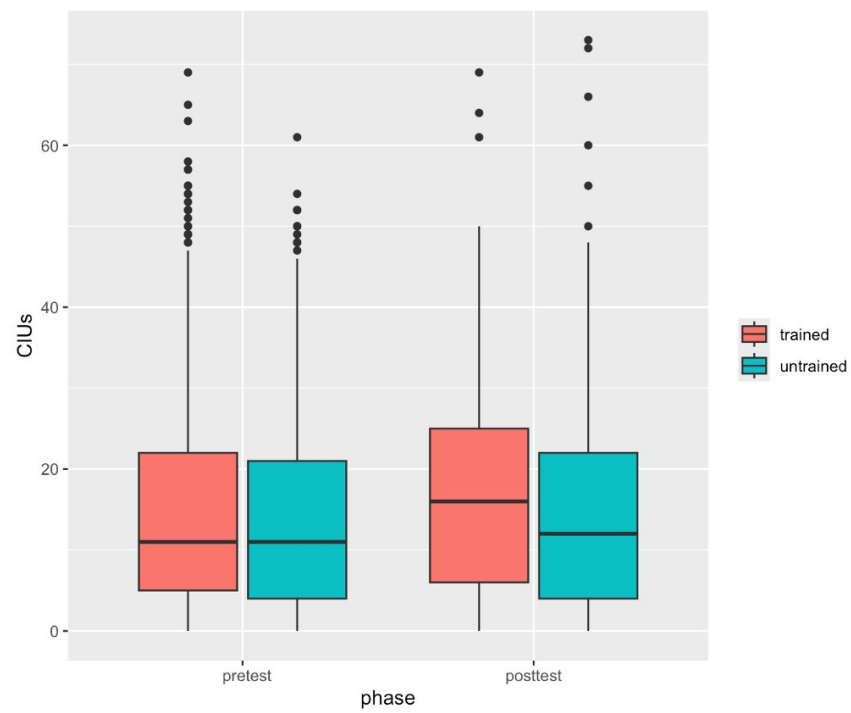
References

1. Rosenbek, J. C., Lemme, M. L., Ahern, M. B., Harris, E. H., & Wertz, R. T. (1973). A treatment for apraxia of speech in adults. *Journal of Speech and Hearing Disorders*, 38(4), 462–472.
2. Cherney, L. R., Halper, A. S., Holland, A. L., & Cole, R. (2008). Computerized script training for aphasia: Preliminary results. *American Journal of Speech-Language Pathology*, 17, 19–34.
3. Kershenbaum, A., Nicholas, M. L., Hunsaker, E., & Zipse, L. (2017). Speak along without the song: what promotes fluency in people with aphasia? *Aphasiology*, 33(4), 405–428.
4. Fridriksson, J., Hubbard, H. I., Hudspeth, S. G., Holland, A. L., Bonilha, L., Fromm, D., & Rorden, C. (2012). Speech entrainment enables patients with Broca's aphasia to produce fluent speech *Brain*, 135(12), 3815–3829.
5. Fridriksson, J., Basilakos, A., Hickok, G., Bonilha, L., & Rorden, C. (2015). Speech entrainment compensates for Broca's area damage. *Cortex*, 69, 68–75.
6. Nicholas, L. E., & Brookshire, R. H. (1993). A system for quantifying the informativeness and efficiency of the connected speech of adults with aphasia. *Journal of Speech, Language, and Hearing Research*, 36(2), 338–350.

Acknowledgments

Research reported in this abstract was supported by the National Institute On Deafness And Other Communication Disorders of the National Institutes of Health under Award Number R21DC018893.

Figure 1. Number of correct information units in trained and untrained stories pre- and 24h post treatment.



First steps towards simulating aphasia in a neural network of human speech processing

Ihintza Malharin^{*1,2}, M. Belén Saavedra^{2,3}, Linkai Peng⁴,
Simona Mancini^{1,5}, and James S. Magnuson^{1,4,5}

¹ BCBL. Basque Center on Cognition, Brain & Language,
Donostia-San Sebastián, (Gipuzkoa), Spain

² UPV/EHU University of the Basque Country, Donostia, (Gipuzkoa), Spain

³ Université de Lorraine, Nancy, France

⁴ Department of Psychological Sciences, University of Connecticut, Storrs, (CT), USA

⁵ Ikerbasque. Basque Foundation for Science, Bilbao, Spain

***corresponding author, i.malharin@bcbl.eu**

Introduction

EARSHOT is the only model of human speech processing that learns to map real speech from multiple talkers to semantic representations (Magnuson et al., 2020). It radically expands the scope of computationally-addressable questions by engaging with the full complexity of natural speech, allowing direct model-human comparisons. We report first steps towards simulating phonological and semantic deficits in aphasia (Landrigan et al., 2021) by damaging connections between EARSHOT layers (see Figure). We simulated naming by presenting spoken words to models and measuring cosine similarity of the output to every word in the lexicon. We tracked error types (phonological, semantic, mixed, unrelated) as damage increased. Results suggest a division of labor, with earlier layers producing phonological encodings and later layers decoding semantics. These results provide a foundation for deeper explorations of aphasia using this model.

Methods

We trained EARSHOT on 1000 high-frequency English words spoken by one talker. EARSHOT maps 256-dimensional spectral slices to semantic vectors (300-dimensional Skip-gram; Mikolov et al., 2013) via 512 hidden nodes (long short-term memory nodes, or LSTMs). At each step, we computed semantic similarity between output and every word in the lexicon, operationalizing EARSHOT's naming/identification response as the word with peak cosine similarity. The undamaged model achieved 95% accuracy.

To simulate damage, we randomly removed increasing proportions of connections between input and hidden, hidden and hidden, and hidden to output layers. We tested all 1000 words at each damage level. We measured semantic (cosine) similarity and phonological similarity (1 - Levenshtein distance normalized by the length of the longest word in a pair) of responses and targets. We classified errors as mixed (both similarities high), phonological (high phonological, low semantic), semantic (low phonological, high semantic), or unrelated (both similarities low).

Results

Before damage, most errors are mixed, with fewer unrelated, semantic and phonological errors. At all damage-location combinations, unrelated errors dominated, with few mixed

errors. Relative proportions of semantic and phonological errors varied by location. "Early" damage (input-hidden) yielded the most phonological errors, which decreased at higher levels. "Late" damage (hidden-output) yielded the most semantic errors. This reflects EARSHOT's internal division-of-labor; it encodes patterns phonologically in its hidden layer, and our results suggest the hidden-output transformation is primarily responsible for decoding semantics.

Next steps

EARSHOT's division-of-labor intuitively suggests lower-level damage impairs phonology most, and higher-level damage most affects semantics. Two limitations must be addressed to enhance clinical relevance. First, EARSHOT lacks phonological output, and so cannot generate nonwords/neologisms. We will add a hidden-layer decoder to provide phonological readout. Second, we are developing a more biologically inspired architecture to better support alignment with brain regions. Despite these limitations, EARSHOT offers a promising platform for simulating aphasia and testing intervention strategies, such as retraining after damage. With further development, it could become a valuable tool for enhancing understanding of aphasia.

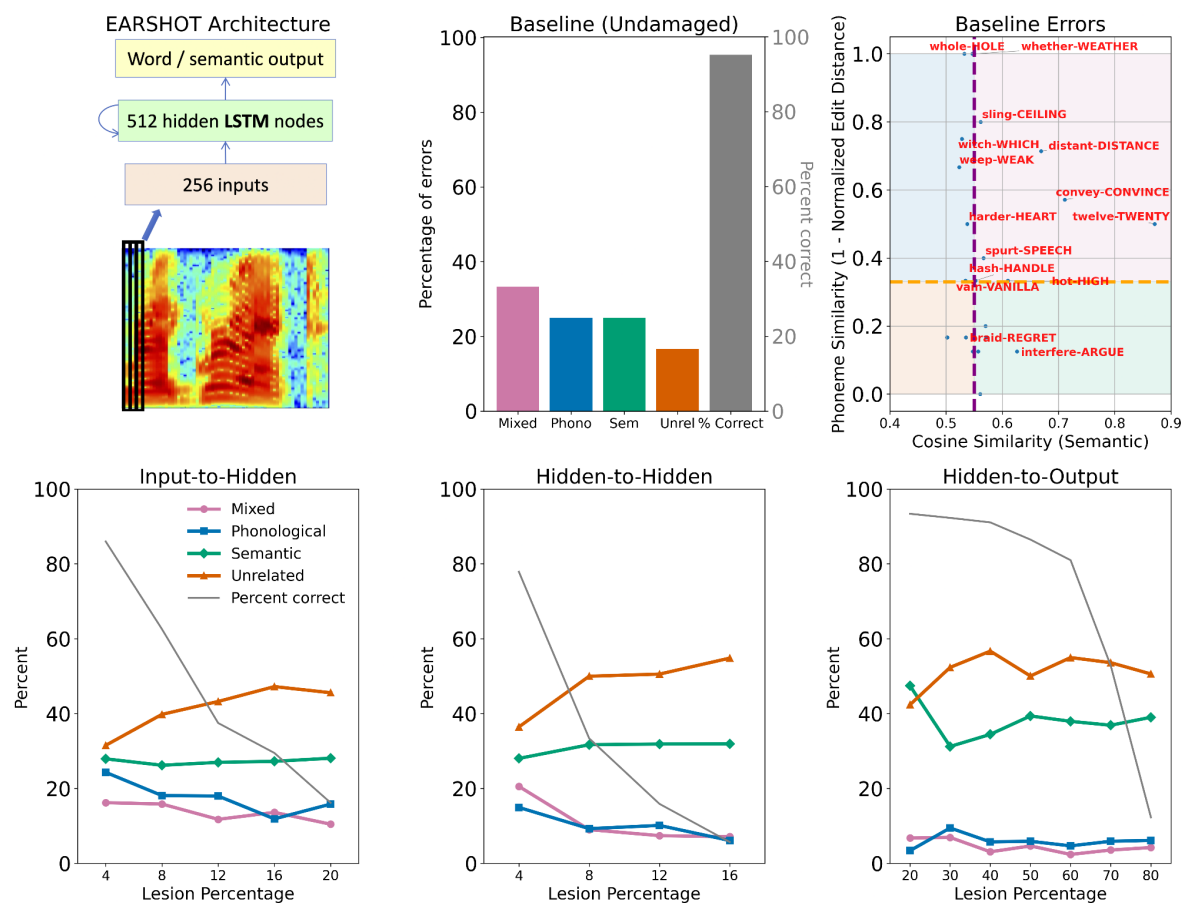
References

- Magnuson, J. S., You, H., Luthra, S., Li, M., Nam, H., Escabi, M., ... & Rueckl, J. G. (2020). EARSHOT: A minimal neural network model of incremental human speech recognition. *Cognitive science*, 44(4), e12823.
- Landrigan, J. F., Zhang, F., & Mirman, D. (2021). A data-driven approach to post-stroke aphasia classification and lesion-based prediction. *Brain*, 144(5), 1372-1383.
- Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). Efficient estimation of word representations in vector space. arXiv preprint arXiv:1301.3781.

Acknowledgments

This project was supported in part by National Science Foundation grant PAC 2043903 (PI JSM), by the Basque Government through the BERC 2022-2025 program, and by the Spanish State Research Agency through BCBL Severo Ochoa excellence accreditation CEX2020-001010-S and through project PID2020-119131GB-I00 (PI JSM). This submission is not part of a symposium or workshop.

Figure 1. Top panels: EARSHOT architecture (showing a real speech spectrogram being input to the model in 10ms frames), proportion of error types and all errors in the Baseline (undamaged) model. Lower panels: proportion of error types and percent correct at each lesion location.



International Practices of Speech-Language Pathologists Working with Bilingual Speakers with Primary Progressive Aphasia

Sonia-Karin Marqués Kiderle¹, Lucas Ansín Gómez², Núria Montagut³, Jade Cartwright⁴, Regina Jokel⁵, Monica Lavoie⁶, Ellen McGowan⁷, Margaret Pozzebon⁸, Bárbara Costa Beber⁹, Guillaume Duboisdindien⁶, Monica Norvik¹⁰, Taiki Sugimoto¹¹, Rosemary Townsend¹², Nina Unger¹³, Ingvild E. Winsnes¹⁰, Anna Volkmer¹⁴, Jeanne Gallée¹¹, Stephanie Grasso^{1*}
On behalf of the International SLP Network

¹ Department of Speech, Language, and Hearing Sciences, The University of Texas at Austin

² Universidad Complutense Madrid

³ Alzheimer's Disease and other Cognitive Disorders Unit, Neurology Service, Hospital Clinic Barcelona

⁴ School of Health Sciences, University of Tasmania

⁵ Temerty Faculty of Medicine, University of Toronto

⁶ Chaire de recherche sur les aphasies primaires progressives – Fondation de la famille Lemaire, Université Laval

⁷ Pennine Care NHS Foundation Trust

⁸ Age Right Speech Pathology

⁹ Department of Speech, Language, and Hearing Sciences, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA)

¹⁰ Department of Linguistics and Scandinavian Studies, University of Oslo

¹¹ Center for Psychometric Analyses of Aging and Neurodegeneration, Department of Medicine, University of Washington

¹² Dyscover Ltd.

¹³ Department of Neurology, University Medicine Greifswald

¹⁴ Department of Psychology and Language Science, University College London

***corresponding author, smgrasso@austin.utexas.edu**

Introduction

Primary Progressive Aphasia (PPA) is a neurodegenerative condition characterized by progressive speech and/or language impairment (Gorno-Tempini et al., 2011; Mesulam et al., 2014), yet most research and clinical guidelines are based on monolingual populations. The lack of research in bilingual populations creates a critical knowledge gap, given over half of the world's population is bilingual (Grosjean, 2010). These gaps present significant challenges for speech-language therapists/pathologists (SLT/Ps), particularly in accurately diagnosing and developing/adapting/tailoring interventions for bilingual individuals with PPA (Gallée et al., 2024; Grasso et al., 2023). Additionally, the educational and clinical needs of SLT/Ps working with multilingual people with PPA remain unreported. This study sought to explore the educational and clinical needs of SLT/Ps working with individuals with PPA, with a particular emphasis on the role of bilingualism and the need to adapt diagnostic and therapeutic practices.

Methods

A multilingual, web-based survey was developed using Qualtrics® and designed according to CHERRIES guidelines. It included five sections: respondent identity, clinical setting and exposure to PPA, educational experiences, clinical decision-making, and perceived areas of need. Distributed globally between April 2023 and January 2024 using a snowball sampling strategy the survey targeted SLP/Ts both with and without multilingual PPA experience. Recruitment occurred via professional networks, international SLP/T associations, social media, and the International SLT/P PPA Network. Quantitative data were largely analyzed using descriptive statistics, whereas open-ended responses were analyzed qualitatively for themes.

Results

A total of 192 responses from SLT/Ps across 27 countries were analyzed (Figure 1). Respondents with multilingual PwPPA experience were more likely to work in urban settings, especially in hospitals, research facilities, and university clinics, whereas those without such experience more commonly worked in private practice (Table 1). Despite high self-reported multilingualism, only 33.4% used more than one language clinically. SLP/Ts with prior multilingual PPA experience were more likely to assess people with PPA in their dominant language and/or conduct independent multilingual evaluations; however, access to validated bilingual assessment tools was limited, with most clinicians relying on informal methods. Formal training of both PPA and bilingualism in neurogenic disorders was minimal, with over half of respondents receiving fewer than two hours of education. Some SLT/Ps supported credentialing bilingual clinicians to ensure quality care, but others expressed concerns about feasibility and accessibility.

Conclusions

Most SLT/Ps begin clinical practice with limited training in both bilingualism and primary progressive aphasia (PPA), resulting in a reported lack of preparedness when working with bilingual individuals with PPA. These challenges are further compounded by a shortage of validated assessment tools designed for bilingual speakers across different languages, as well as a lack of empirically supported treatment protocols. Without training and tools that reflect the complex interaction between bilingualism and neurodegeneration, there is an increased risk of relying on methods that are inappropriate or ineffective for this population. To provide equitable and effective assessment and treatment, the field must prioritize the development of novel training approaches for current practitioners, expand language-specific and bilingual assessment resources, and increase research efforts focused on bilingual individuals with PPA.

References

- Gallée, J., Cartwright, J., Grasso, S., Jokel, R., Lavoie, M., McGowan, E., Pozzebon, M., Beber, B. C., Duboisindien, G., Montagut, N., Norvik, M., Sugimoto, T., Townsend, R., Unger, N., Winsnes, I. E., & Volkmer, A. (2024). Global Perspectives on the Management of Primary Progressive Aphasia. *Research Square*, rs.3.rs-4100219. <https://doi.org/10.21203/rs.3.rs-4100219/v1>
- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., Ogar, J. M., Rohrer, J. D., Black, S., Boeve, B. F., Manes, F., Dronkers, N. F.,

- Vandenberghe, R., Rascovsky, K., Patterson, K., Miller, B. L., Knopman, D. S., Hodges, J. R., Mesulam, M. M., & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006–1014. <https://doi.org/10.1212/WNL.0b013e31821103e6>
- Grasso, S. M., Rodríguez, C. A. W., Colomer, N. M., Kiderle, S.-K. M., Sánchez-Valle, R., & Santos, M. Á. S. (2023). Bilingual Primary Progressive Aphasia: A Scoping Review of Assessment and Treatment Practices. *Journal of Alzheimer's Disease : JAD*, 96(4), 1453–1476. <https://doi.org/10.3233/JAD-230673>
- Grosjean, F. (2010). *Bilingual: Life and reality*. Harvard University Press. <https://doi.org/10.4159/9780674056459>
- Mesulam, M.-M., Rogalski, E. J., Wieneke, C., Hurley, R. S., Geula, C., Bigio, E. H., Thompson, C. K., & Weintraub, S. (2014). Primary progressive aphasia and the evolving neurology of the language network. *Nature Reviews Neurology*, 10(10), 554–569. <https://doi.org/10.1038/nrneurol.2014.159>

Acknowledgments

This research was supported by the National Institute on Aging R01AG080470 to SMG and SMK (doctoral student), U24AG074855 to J.G., Role: Postdoctoral Fellow, the Estelle and Carl Epstein Family philanthropic funds (R.J.), and the National Institute on Health and Care (Advanced Fellowship NIHR302240 to A.V.). In addition to the funding sponsors, the authors wish to thank Fasihah Irfani Fitri and members of the International SLT/P PPA Network for their specific contributions in distributing this survey internationally.

Figure 1. Geographic Distribution of Survey Participants (Speech-Language Pathologists, N = 192)

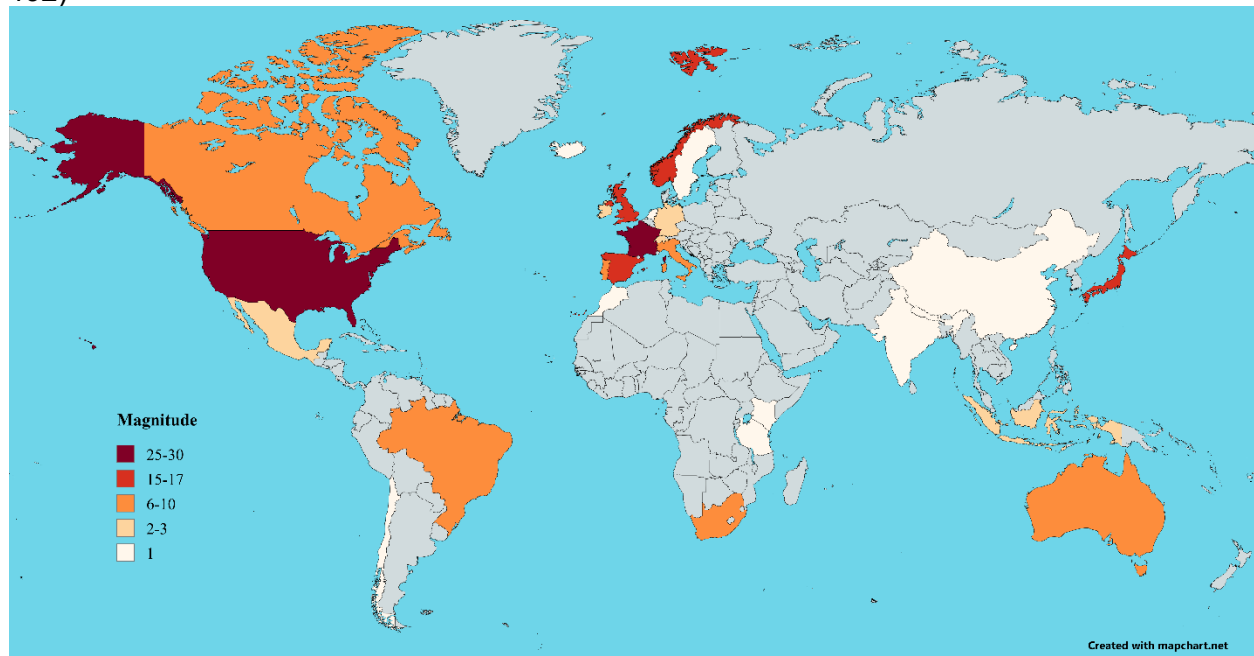


Table 1. Patterns Associated with Education and Clinical Practice Between Speech-Language Pathologists with and without Multilingual PwPPA Experience

Domain	With Multilingual PwPPA Experience (n=75)	Without Multilingual PwPPA Experience (n=117)
Demographics		
Age (mean $\pm$ SD)	40.3 $\pm$ 12.4	38.0 $\pm$ 11.0
Female (%)	85%	86%
Years Clinical Experience (mean $\pm$ SD)	14.9 $\pm$ 11.1	10.9 $\pm$ 10.9
Years Working with PPA (mean $\pm$ SD)	8.0 $\pm$ 7.5	3.9 $\pm$ 4.1
Identifies as Multicultural (%)	41.5%	16.9%
Multilingual Clinician (%)	67.6%	40.0%
Urban Practice Setting (%)	63.5%	52.7%
Education		
Learned about PPA during University education (%)	50.7%	56.4%
PPA University Education (<2 hrs) (%)	52.2%	62.7%
Bi/multilingualism Education (>5 hrs, all clients) (%)	40.7%	47.4%
Bi/multilingualism Education (>5 hrs, neurogenic disorders) (%)	34.8%	22.2%
Clinical Practice		
Uses $\geq$ 2 Languages in Practice (%)	33.3%	7.5%
Provides Multilingual Assessment (any) (%)	70.7%	26.5%
Provides Multilingual Assessment Independently (%)	18.7%	1.8%
Language Selection for Assessment: Dominant Language (%)	55%	41%
Language Spoken by SLT/P	29%	29%
Part of Interdisciplinary Team (%)	68.9%	61.8%
Works in Research Setting (%)	28.4%	10.9%
Licensure and Global Context		
	<i>(All participants, not grouped)</i>	
Countries without Licensure Requirement (%)	~56% (varies by region)	
Support for Licensure (%)	~53% overall	
Common reasons for licensure support	Ensure quality care, verify qualifications	
Common reasons against licensure	Limited access, practicality concerns	

Multimodal analysis of linguistic, emotional, and visual attention processing of naturalistic movie stimuli in persons with aphasia

Manuel Jose Marte^{1,2}, Bryce Gillis², Kari Goldin², Xuehu Wei^{2,3}, Colin Galvin³, Laura Rigolo³, Yanmei Tie³, Swathi Kiran¹, & Einat Liebenthal²

Center for Brain Recovery, Boston University¹, Institute for Technology in Psychiatry, McLean Hospital, Harvard Medical School², Department of Neurosurgery, Brigham and Women's Hospital, Harvard Medical School³

Introduction

Post-stroke aphasia, beyond language impairment, often involves broader disruptions of real-time information processing crucial for navigating dynamic communication (Cahana-Amitay & Albert, 2015). Naturalistic paradigms like movie-viewing engage these neural systems in concert, potentially offering more ecologically valid insights into communication challenges (Finn & Bandettini, 2021; Hasson et al., 2008). This study leverages multimodal measures derived from movie-viewing – including linguistic processing, emotional reactivity patterns, and eye-gaze dynamics – to better understand the real-world communication challenges faced by persons with aphasia (PWA).

Methods

Participants included 50 PWA (WAB-AQ: $M=83.28$, $SD=16.77$) and 50 healthy controls (HC). Participants watched 5-8 emotionally engaging movie clips (2-5 minutes each) while providing moment-by-moment valence ratings. Eye movements were recorded in all HC and a subset of 13 PWA. Post-clip tasks included verbal summaries, comprehension questions, and antonym generation prompts.

We analyzed group differences using mixed-effects models. Measures included: (1) linguistic processing (movie-based comprehension and antonym generation accuracy); (2) emotional reactivity (magnitude and direction of moment-by-moment deviations of valence ratings from HC group means, measured as root mean squared z-scores and overall Euclidean distance; valence rating complexity across timescales, measured as sample entropy); and (3) visual attention (horizontal and vertical gaze time course correlations with HC group means; fixation metrics – rate, number, duration, gaze path length, and spatial entropy). Support Vector Classifier (SVC) and Least Absolute Shrinkage and Selection Operator (LASSO) classifiers identified the most discriminative features between groups.

Results

Compared to HC, PWA demonstrated significantly lower accuracy on movie-based comprehension and antonym tasks ($p<.001$).

PWA exhibited atypical emotional reactivity, with greater moment-to-moment deviations in valence ratings ($p=.001$) and overall rating pattern dissimilarity ($p<.001$). Their emotional responses were less complex ($p<.001$), showing reduced valence variability across different timescales.

Altered visual attention patterns in PWA included significantly reduced horizontal and vertical gaze synchronization with HC (both $p<.001$). Fixation analyses indicated trends

towards PWA having a higher fixation rate, more numerous fixations, and shorter fixation durations (all $p \leq .108$). No significant effects emerged for gaze path length or spatial entropy (both $p \geq .415$).

The SVC robustly discriminated groups (AUC=0.925, 95% CI: 0.835–0.989; Table 1, Figure 1AB). Movie-based linguistic measures were strong predictors; emotional reactivity measures contributed more modestly. A LASSO classifier for the PWA eye-tracking subset also distinguished groups (AUC=0.842, 95% CI: 0.696-0.969). Movie-based antonym generation remained key, while eye-tracking metrics including mean intersubject correlation values and fixation rates were highly predictive.

Conclusions

Relative to HC, PWA exhibited impaired linguistic performance, atypical emotional reactivity, and altered gaze behavior. Emotional reactivity results indicated a more dissimilar yet less complex pattern of processing. Gaze behavior potentially reflected difficulties tracking salient visual elements in dynamic scenes and less efficient visual processing strategies. Classification modeling showed that movie-based linguistic performance was highly predictive of group membership; real-time emotional valence ratings and eye-gaze metrics provided additional predictive value, indicating that aberrant emotional reactivity and visual processing contribute to the cognitive-linguistic profile of aphasia. These findings highlight the value of assessing information processing across domains in dynamic, ecologically relevant settings in aphasia. Derived metrics may offer objective markers of processing difficulties beyond traditional language scores, potentially informing tailored rehabilitation.

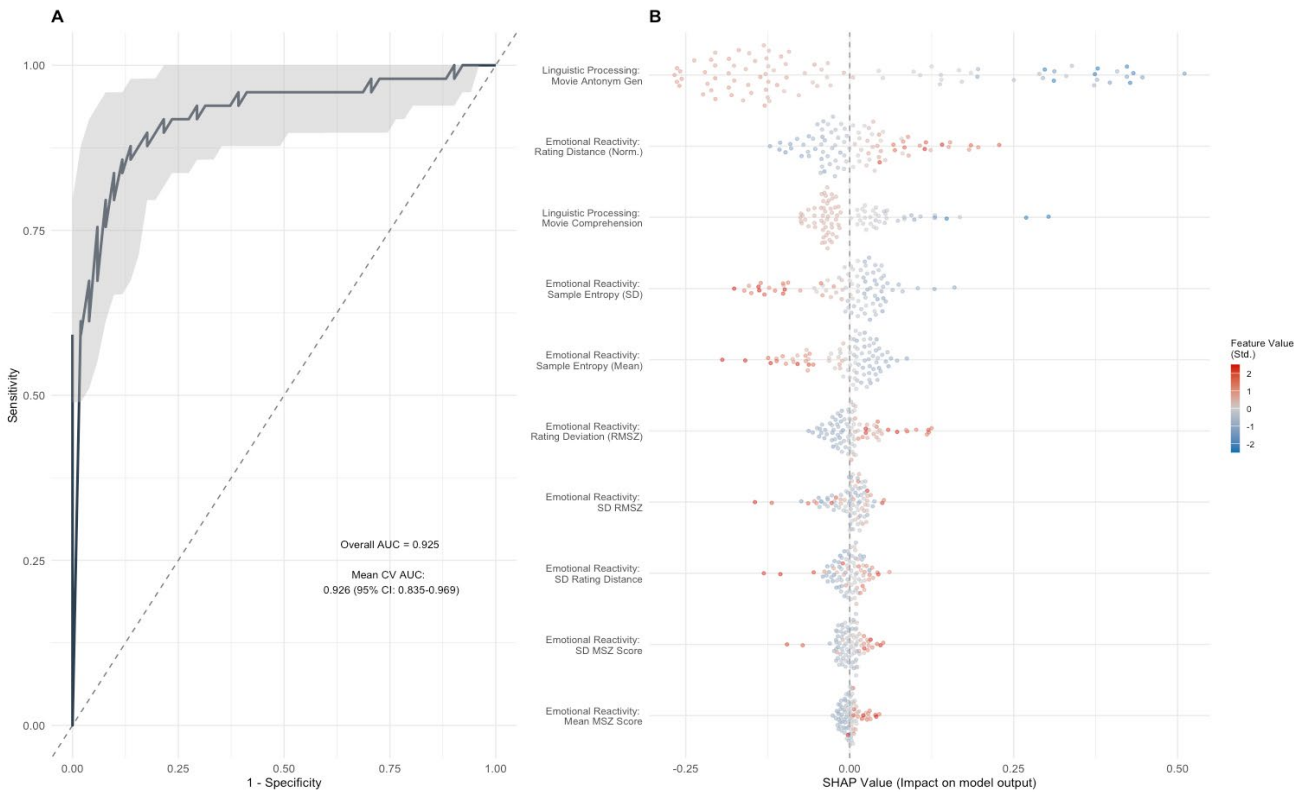
References:

- Cahana-Amitay, D., & Albert, M. L. (2015). Neuroscience of Aphasia Recovery: The Concept of Neural Multifunctionality. *Current Neurology and Neuroscience Reports*, 15(7), 41.
- Finn, E. S., & Bandettini, P. A. (2021). Movie-watching outperforms rest for functional connectivity-based prediction of behavior. *NeuroImage*, 235, 117963.
- Hasson, U., Yang, E., Vallines, I., Heeger, D. J., & Rubin, N. (2008). A Hierarchy of Temporal Receptive Windows in Human Cortex. *Journal of Neuroscience*, 28(10), 253

Table 1. Classification Performance and Feature Importance of SVC and LASSO Models.

Comparison	SVC (50 AP / 50 HC)	LASSO (13 AP / 50 HC)
Metric	Classification Performance	
AUC (95% CI)	0.925 (0.835-0.969)	0.842 (0.696-0.987)
Sensitivity	0.727 (0.540-0.854)	0.833 (0.583-1.000)
Specificity	0.900 (0.634-0.979)	0.780 (0.660-0.900)
Accuracy	0.823 (0.744-0.880)	0.790 (0.677-0.887)
	Feature Importance	
1 st	Movie Antonym Gen	Movie Antonym Gen
2 nd	Valence Rating: Distance	Eye-gaze: Intersubject Correlation
3 rd	Movie Comprehension	Eye-gaze: Fixation Rate

Figure 1AB. SVC Model Performance and Feature Contributions. Panel (A) shows the classifier's ability to distinguish between AP and HC groups. Panel (B) shows a SHapley Additive exPlanations (SHAP) beeswarm plot, illustrating the impact of the top 10 features on the model's predictions. Features are ranked by importance. The horizontal position of points shows the SHAP value (impact on prediction), and color indicates the feature's standardized value (high or low). For example, higher "Rating Distance" scores push predictions towards the AP class.



The N400 and Semantic Priming in a Naturalistic Cross-Modal Priming Paradigm

Ian A. Martindale^{12*}, and Seana Coulson²

¹ Speech, Language & Hearing Sciences, San Diego State University, San Diego, (CA), USA

² Cognitive Science, University of California San Diego, La Jolla, (CA), USA

***Corresponding author, imartindale4976@sdsu.edu**

Introduction

Cross-modal priming involves presenting a spoken prime followed by a visual target to probe how meaning is activated across modalities (Tabossi 1996). In aphasia, the paradigm has been used to examine sentence-level deficits (Howells & Cardell, 2014), but its traditional behavioral requirements (lexical decision, naming) can exclude patients with severe impairments. Notably, combined event-related potential (ERP) work shows that behavioral indices of cross-modal priming are accompanied by N400 effects (e.g., Holcomb & Anderson, 1993). It remains unclear, however, whether the effect persists without an overt task. In the present study (Table 1), we tested a cross-modal paradigm for eliciting the N400 using written word probes either semantically related or unrelated to the immediately preceding spoken podcast discourse. We ask whether visually presented words related to the discourse evoked a less negative N400 than the same words presented at points where they were unrelated. Establishing a passive discourse-level N400 in young healthy adults would serve as foundation for applying these methods to individuals with aphasia.

Methods

We recorded EEG (2048 Hz, 0.16-100 Hz bandpass filter) in an electromagnetically shielded chamber using a BioSemi ActiveTwo system with thirty-two active electrodes at standard 10–20 sites. Sixteen UC San Diego undergraduates ($M_{age}=20.4$) participated for course credit. 10 one-minute clips from NPR's *This American Life* were presented twice within one EEG session. Between listens, participants completed another study (~25 minute length). During each clip, probe words briefly replaced a fixation cross in the center of the screen. Half the probes were related to the immediately preceding spoken context and half were unrelated (86 per condition; 172 across one listen). Probes were repeated such that every word served both roles (see Table 1). Half the words were initially presented in a related position and half in an unrelated position. A norming study, with different participants, validated the probe–context relatedness manipulation. Single-trial linear mixed-effects regressions (LMER) were used to predict mean amplitude (300–500 ms window) including Relatedness (related vs. unrelated), Listen (first vs. second), scalp coordinates (x, y, z), and their interaction as effects of interest, with participant and item as random intercepts.

Results

Relatedness showed no main effect ($p = .68$), but did show a significant interaction with the scalp x-axis ($p=0.04$) and the z-axis ($p=0.004$) indicating Unrelated probes were more

negative than Related ones over centro-parietal channels. Likewise, the main effect of Listen was not significant ($p = .46$), but an interaction between Listen and scalp z-axis was observed ($\beta = -0.57$, $SE = 0.19$, $t = -3.05$, $p = .002$). No interaction between Relatedness and Listen emerged ($p = .48$).

Conclusions

Words presented visually during the podcast reliably elicited an N400 relatedness effect, despite the absence of a behavioral task. The podcast likely activates conceptual information that facilitates semantic retrieval of the meaning of the visually presented probes. This evidence from 16 undergraduate participants serves as foundation for future work using N400 ERPs in our naturalistic cross-modal podcast paradigm, to investigate discourse processing in individuals with aphasia.

References

- Holcomb, P. J., & Anderson, J. E. (1993). Cross-modal semantic priming: A time-course analysis using event-related brain potentials. *Language and Cognitive Processes*, 8(4), 379–411.
- Howells, S. R., & Cardell, E. A. (2015). Semantic priming in anomic aphasia: A focused investigation using cross-modal methodology. *Aphasiology*, 29(6), 744-761.
- Tabossi, P. (1996). Cross-modal semantic priming. *Language and Cognitive Processes*, 11(6), 569-576.

Acknowledgments

Research reported in this abstract was supported by the National Institute on Deafness and Communication Disorders of the National Institutes of Health under Award Number T32 DC007361. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Figure 1. A: Grand-averaged ERPs at a posterior electrode cluster for semantically related (black) and unrelated (red) word probes B:Blank head showing the posterior cluster plotted in A and a topographic map showing the N400 relatedness effect (mean amplitude 300-500ms in unrelated minus related waveforms).

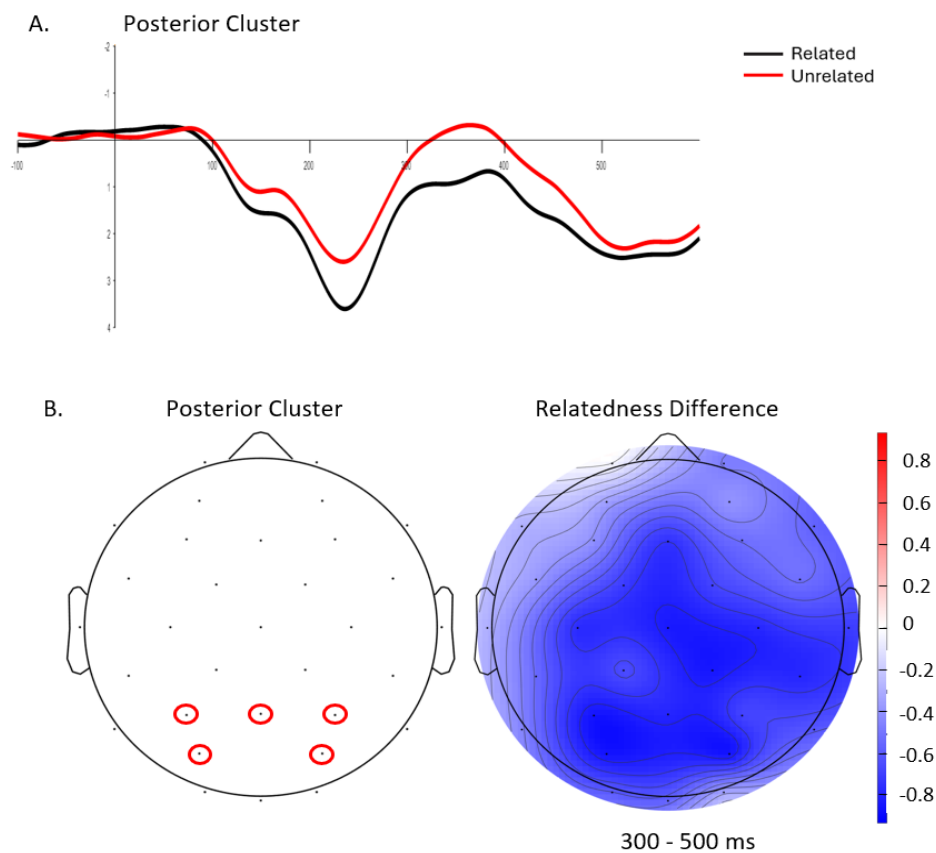


Table 1. Discourse and probe examples across conditions

Spoken-discourse audio clip	Probe word	Condition
"...Pinned to it was a rose that was completely withered..."	Dried	Related
"...My brother Kenny, best friend Ian, and I went along..."	Dried	Unrelated
"...A salt and pepper shaker sat on the kitchen table..."	Dinner	Related
"...On a nightstand, I found a pair of eyeglasses folded..."	Dinner	Unrelated

Assessment of Social Cognition in Individuals with Traumatic Brain Injury and Neurotypical Adults.

Niya Mathew^{1*}, Pooja Chandrashekhar², and Hema Nagaraj³

¹Speech Language Pathology, All India Institute Of Speech and Hearing, Mysore, India

***corresponding author, Niyamattathil21@gmail.com**

Introduction

Traumatic brain injury (TBI) often results in long-term impairments in higher-order cognitive functions, notably social cognition. Among these, Theory of Mind (ToM) and social norms perception are especially vulnerable. These deficits impact interpersonal functioning and social reintegration. Despite growing research interest, social cognition remains under-assessed in clinical practice. There is limited evidence on how executive dysfunction may relate to deficits in ToM and social reasoning among adults with TBI.

Methods

Participants included 8 individuals with TBI and 30 neurotypical adults with no history of brain injury. Social Norms Questionnaire (SNQ-22), Trail Making Test (TMT) and a ToM test were administered to the participants.

Results

The TBI group (n = 8) demonstrated impairment in executive functioning and social cognition. The mean completion time on the Trail Making Test Part A (TMT-A) was 129.09 s (SD = 93.49 s), and for Part B (TMT-B), completed by six participants, the mean was 282.72 s (SD = 106.38s). Performance on the Social Norms Questionnaire (SNQ-22) yielded a mean score of 16.88 (SD = 2.64), while the Theory of Mind (ToM) task showed a mean score of 16.75 (SD = 2.49). These results reflected considerable individual variability, indicating reduced cognitive flexibility and challenges in inferencing social information among individuals with TBI.

Conclusions

The present findings suggest that individuals with TBI exhibit deficits in executive functioning and social cognition, with considerable variability observed across participants. Prolonged completion times on TMT-A and TMT-B indicate reduced cognitive flexibility and processing speed, while performance on the SNQ-22 and ToM tasks highlights subtle difficulties in understanding social norms and mental state reasoning. These findings emphasize the need for individualized assessment and intervention in the domain of social cognition, particularly when executive function deficits are present. Incorporating culturally sensitive tools may further enhance diagnostic accuracy and support the development of functionally relevant rehabilitation strategies for adults with TBI.

References

- Adams, C. (2005). Social communication intervention for school-age children: Rationale and description. *Seminars in Speech and Language*, 26(3).
- Lin, X. G., Zhang, X. L., Liu, Q. Q., Zhao, P. W., Zhang, H., Wang, H. S., & Yi, Z. Q. (2021). Theory of mind in adults with traumatic brain injury: A meta-analysis. *Neuroscience and Biobehavioral Reviews*, 121.
- McDonald, S. (2013). Impairments in social cognition following severe traumatic brain injury. In *Journal of the International Neuropsychological Society*, 19, (3).

Corticobasal Syndrome Associated with Prominent Phonological Dyslexia: A Case Report

**Kana Matsuda^{1*}, Naoko Nakamura², Ryotaro Sanda², Yoshinori Hirata²,
Hidehiro Ishikawa², Yukito Ueda³, Yutaka Tanaka⁴, Akihiro Shindo^{1,2}**

¹Department of Dementia Prevention and Therapeutics, Mie University Graduate School of Medicine, Tsu, Japan

²Department of Neurology, Mie University Graduate School of Medicine, Tsu, Japan

³Department of Speech therapy, Osaka Kawasaki Rehabilitation University, Kaizuka, Japan

⁴Tanaka Clinic, Ikoma, Japan

***corresponding author, m-kana@med.mie-u.ac.jp**

Introduction

Phonological dyslexia is an acquired reading disorder characterized by a severe impairment in reading nonwords, despite relatively preserved ability to read real words. Corticobasal syndrome (CBS) is a rare neurodegenerative disorder presenting with a combination of cortical and extrapyramidal symptoms. Although CBS can present with progressive non-fluent aphasia (PNFA) as a primary symptom, phonological dyslexia has not been reported in CBS.

Methods

A woman in her 70s presented with a chief complaint of right upper limb tremor and gait disturbance. She underwent neuropsychological testing, detailed language evaluation, brain MRI, and IMP-SPECT.

Results

Neuropsychological assessment revealed impairments in memory and frontal lobe function, as well as constructional apraxia, ideomotor apraxia, acalculia, and right-sided cortical sensory deficits. Language assessment using the Western Aphasia Battery showed an aphasia quotient of 84, indicating relatively preserved comprehension, though some decline was noted in understanding long or non-reversible sentences. Mild apraxia of speech was observed. Repetition of both real and nonwords was intact. Reading aloud of both kana and kanji was generally preserved. However, when asked to read nonwords written in kana (e.g., "Tayoui" which was read as "Taiyo" meaning "sun" in English), the patient replaced all responses with real words. Writing was impaired due to apraxia of the right hand, and in a character tile rearrangement task designed to assess kana writing, the patient was unable to complete any of the items correctly.

Imaging revealed mild hypoperfusion in the bilateral frontal lobes and left parietal lobe on IMP-SPECT, alongside left-predominant cerebral atrophy on brain MRI.

Conclusions

Previous studies have suggested that lesions involving the angular gyrus, lateral occipital gyrus, and supramarginal gyrus are associated with phonological dyslexia. CBS typically

causes atrophy extending from the frontal to parietal lobes, particularly around the central sulcus. These findings suggest that phonological dyslexia can occur in CBS, and language evaluation in such patients should include tasks sensitive to phonological processing.

References

Beauvois, M.F. & Derouesne, J. (1979). Phonological alexia; Three dissociations. *J. Neurol. Neurosurg. Psychiatry*, 42: 1115-1124.

Sakurai, Y. (2011). Lesion localization of non-aphasic alexia and agraphia. *Clin Neurol*, 51: 567-575.

Jeremy, J.T. (2008). Two types of phonological dyslexia – A contemporary review. *CORTEX*, 44: 698-706.

Barcelona Scale for Buccophonatory Apraxia in Primary Progressive Aphasia: A Longitudinal Case Series

Núria Montagut^{1,2}, Sergi Borrego-Écija^{1,2}, Jorge Herrero¹, Cristina Vela¹, Mircea Balasa^{1,2}, Albert Lladó^{1,2}, Stephanie Grasso³, Raquel Sánchez-Valle^{1,2}

¹Alzheimer's Disease and other Cognitive Disorders Unit. Hospital Clínic de Barcelona, Barcelona, Spain

²Fundació de Recerca Clínic Barcelona-IDIBAPS, Barcelona, Spain

³Department of Speech, Language, and Hearing Sciences, University of Texas at Austin, USA

***Núria Montagut, nmontagu@clinic.cat**

Introduction

Primary progressive aphasia (PPA) is a neurodegenerative disorder characterized by progressive worsening of speech and/or language. Three variants are described, each with a different profile of communication impairments (Gorno-Tempini et al., 2011). We still lack a practical and objective scale for the quantitative rating of buccophonatory apraxia, which is particularly necessary for non-fluent variant of PPA (nfvPPA). The aim of the current study was to evaluate the usefulness of the Barcelona scale (Montagut et al., 2025) for monitoring the progression of buccophonatory apraxia in patients with nfvPPA.

Methods

Twenty Spanish and Catalan speaking PPA participants (nfvPPA=10, logopenic variant=4, semantic variant= 6) were evaluated with the Barcelona scale for buccophonatory apraxia in their dominant language. The scale was administered by a speech therapist specialized in neurodegenerative diseases. Verbal and non-verbal apraxia was assessed with a total score expressed in seconds where a higher scores indicates poorer performance. Performance was assessed at 6 -and 12- months follow-up.

Results

NfvPPA participants showed higher total scale scores compared to logopenic and semantic variant participants. The change in buccophonatory apraxia total scores was statistically significant in the nfvPPA at 6 and 12 months follow up ($p<0.05$ both), indicating worsening apraxia (Figure 1). We observed a trend of poorer performance on verbal (i.e., phonation, simple and alternating diadochokinesias, word repetition and reading) and non-verbal (oral gestures and sound) tasks.

Conclusions

The Barcelona scale for buccophonatory apraxia is useful to quantify the progression of buccophonatory apraxia in patients with nfvPPA. It provides a practical, standardized tool for tracking motor speech impairments longitudinally in clinical and research settings.

These findings support its potential utility for disease monitoring and treatment planning in non-fluent variant PPA.

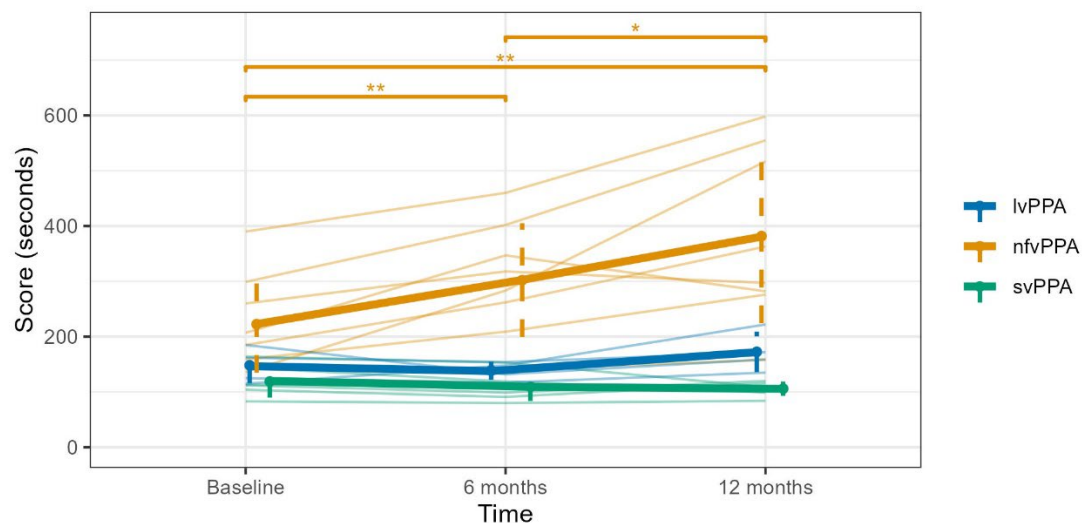
References

- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., ... & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.
- Montagut, N., Borrego-Écija, S., Herrero, J., Lladó, A., Balasa, M., Muñoz, E., Valdeoriola, F., & Sánchez-Valle, R. (2025). Barcelona scale for buccophonatory apraxia: Quantitative assessment tool. *Neurologia*, 40(1), 48–56.

Acknowledgments

Núria Montagut was supported by a research scholarship from the Hospital Clínic de Barcelona

Figure 1.



Simulating Semantic Paraphasia with Japanese Large Language Models

Saori Morita^{1*}, Yuto Harada¹, Taiga Naoe², Tsukasa Okimura², and Yohei Oseki¹

¹ Department of Language and Information Sciences,
The University of Tokyo, Tokyo, Japan

² Medical Institute of Developmental Disabilities Research,
SHOWA Medical University, Tokyo, Japan

*msaori6012@g.ecc.u-tokyo.ac.jp

Introduction: LLMs have shown human-like behavior, prompting comparisons to human cognition. Indeed, some studies simulate psychiatric symptoms like thought disorder, and few studies test if LLMs mimic aphasic language impairments. Based on previous findings that aphasia patients can often recall high-frequency words but have difficulty retrieving low-frequency ones (Bastiaanse et al., 2015), this study investigates whether LLMs can simulate semantic paraphasia—an aphasic error involving semantically related substitutions.

Methods: This study used llm-jp-3-13B-instruct, a 40-layer Japanese LLM, and applied structured pruning with LLM-Pruner (Ma et al., 2023). Nine models were generated by applying L1-based pruning to overlapping 5-layer segments (Layers 1–5 through 36–39), using a maximum pruning ratio of 7.3%. Each model repeated 200 nouns (100 high-frequency, 100 low-frequency) selected from the Wikipedia-Japanese 2023-07-20 corpus. Evaluations included task accuracy and semantic similarity between inputs and outputs, measured by cosine similarity (−1 to 1) using Word2Vec-trained Japanese Wikipedia entity vectors (Mikolov et al., 2013). Values below −0.1 typically indicated non-lexical outputs such as punctuation.

Results: Low-frequency words were reproduced less accurately than high-frequency ones, especially in models with impairments to Layers 1–5, 11–15, 16–20, and 35–39. As shown in table1, the sharpest decline occurred in the model with Layers 1–5 pruned, where accuracy dropped from 88% to 12%, highlighting the importance of early layers. Semantic paraphasia-like errors were identified using cosine similarity from 18 clinical word pairs from previous studies (Matsuda et al., 1999; Furumoto & Kitano, 2002; Miyamoto et al., 2007; Kojima, 2015). Similarity scores across the 18 cases were normally distributed. Based on this, we defined the range indicative of potential paraphasia-like errors as 0.47 ± 0.23 (i.e., 0.24 to 0.70). A previous study by McKinney-Bock and Bedrick (2019), conducted with English-language models and datasets, reported a threshold of 0.51 for identifying such errors, which may serve as a useful point of comparison.

Discussion: Pruning mid-level layers, especially Layers 11–15, led to the most significant decline, while pruning deeper layers had minimal impact, suggesting that mid-level layers play a critical role in lexical retrieval. However, in evaluating semantic paraphasia based on the similarity between input and output words, a large number of non-lexical outputs were generated, and only a small portion fell within the similarity range previously

identified as indicative of semantic paraphasia. Thus, while the results suggest that LLMs may be capable of reproducing symptoms resembling semantic paraphasia, our findings also highlight the need to refine current methods to better fully simulate a broader range of semantic paraphasic errors. Further improvements are needed not only in the damage techniques applied to the models, but also in task design and prompt engineering. Nevertheless, if successful, this approach may offer a novel avenue for understanding language impairments through LLM-based simulation.

Conclusion: Repetition accuracy varied across models. Pruning mid-level layers, especially Layers 11–15, caused the greatest decline, suggesting their key role in lexical retrieval. While some outputs resembled semantic paraphasia, most were non-lexical, indicating current methods need refinement. Enhancements in damage techniques, task design, and prompt engineering are essential. Nonetheless, LLM-based simulation holds promise for understanding language impairments.

References

- Bastiaanse, R., Wieling, M., & Wolthuis, N. (2015). The role of frequency in the retrieval of nouns and verbs in aphasia. *Aphasiology*, 30(11), 1221–1239.
- Fradkin, I., Nour, M. M., & Dolan, R. J. (2023). Theory-driven analysis of natural language processing measures of thought disorder using generative language modeling. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 8(10), 1013–1023.
- Furumoto, H., & Kitano, K. (2002). Lack of awareness of semantic paraphasia and dissociation from self-repair of phonemic paraphasia in Wernicke's aphasia: Relationship between meaning and "lexical items," and continuity and difference of aphasia due to posterior brain damage. *Japanese Journal of Cognitive Neuropsychology*, 5, 1–8.
- Izumi Laboratory. (2023). *Wikipedia Japanese dataset*. Hugging Face.
- Kojima, T. (2015). Language disorders in adults: Aphasia. *JOHNS*, 31(11), 1553–1557. Tokyo Igakusha.
- National Institute of Informatics. (2023). *llm-jp-3-13b-instruct*. Hugging Face.
- Ma, X., Fang, G., & Wang, X. (2023). LLM-Pruner: On the structural pruning of large language models. *Advances in Neural Information Processing Systems*, 36, 21702–21720.
- McKinney-Bock, K., & Bedrick, S. (2019). *Classification of Semantic Paraphasias: Optimization of a Word Embedding Model*. In *Proceedings of the 3rd Workshop on Evaluating Vector Space Representations for NLP* (pp. 52–62).
- Matsuda, M., Suzuki, N., & Mizuta, H. (1999). The meaning of paraphasias in the language production process of aphasic patients. *Aphasiology Research*, 19(3), 170–181.
- Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). Efficient estimation of word representations in vector space. *arXiv*.
- Miyamoto, M., Ohtsuka, Y., & Hashimoto, K. (2007). A case of repetition disorder characterized by semantic paraphasias and lexicalization of non-words: A comparison with deep dysphasia. *Japanese Journal of Speech, Language, and Hearing Research*, 4(3), 150–158.

Mocobeta. *Janome: Japanese morphological analysis tool*.

Silver, L. S., & Halpern, H. (1992). Word-finding abilities of three types of aphasic subjects. *Journal of Psycholinguistic Research*, 21(5), 317–348.

Zhao, W. X., Zhou, K., Li, J., Tang, T., Wang, X., Hou, Y., Min, Y., Zhang, B., Zhang, J., Dong, Z., Du, Y., Yang, C., Chen, Y., Chen, Z., Jiang, J., Ren, R., Li, Y., Tang, X., Liu, Z., Liu, P., Nie, J.-Y., & Wen, J.-R. (2025). *A survey of large language models*. *arXiv*.

Acknowledgments

We gratefully acknowledge the support of JSPS KAKENHI Grant Numbers 23H05493 and 25 KJ0884.

Figure 1. Distribution of cosine similarity scores between target and output words for each pruned model. The figure shows the frequency with which output words fell into each cosine similarity range. Models with pruning in early or middle layers tend to produce outputs with extremely low similarity scores (e.g., -0.1 to 0.1), often corresponding to non-lexical items. By contrast, outputs with scores around 0.47 may reflect semantically related substitutions, resembling semantic paraphasia.

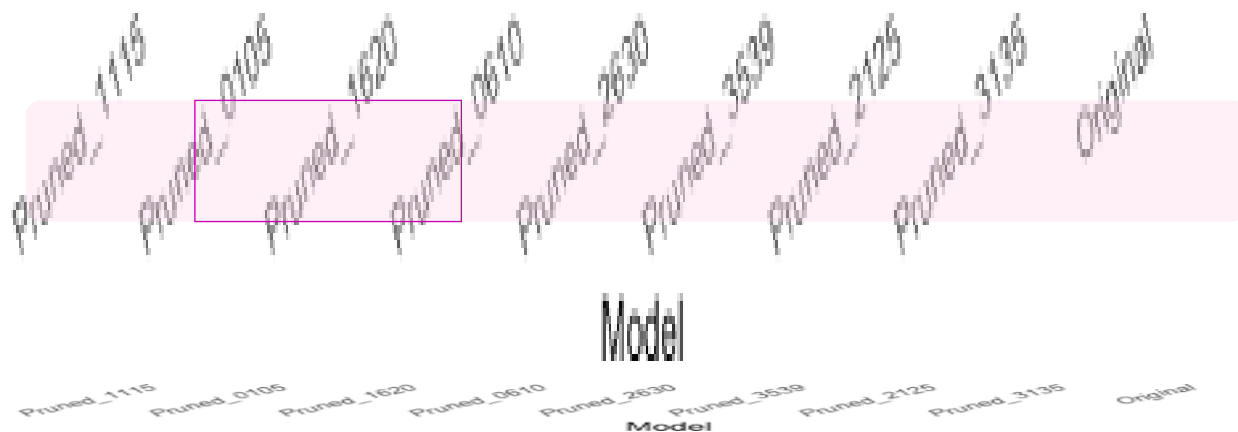


Table1: Accuracy for High-Frequency and Low-Frequency Words in Each Models. An accuracy of 1.00 indicates that the model correctly repeated all the target words.

	Original	Pruned 0105	Pruned 0610	Pruned 1115	Pruned 1620	Pruned 2125	Pruned 2630	Pruned 3135	Pruned 3539
High Frequency	0.98	0.24	0.80	0.17	0.40	0.97	0.79	0.98	1.00
Low Frequency	0.88	0.12	0.66	0.13	0.29	0.87	0.75	0.88	0.83

Cerebello-cerebral Functional Connectivity in Primary Progressive Aphasia

Jamie L. Murter^{1*}, Rajani Sebastian¹, Andreia V. Faria¹, Rhonda B. Friedman², Aaron M. Meyer², Sarah F. Snider², Argye E. Hillis¹, Donna C. Tippett¹

¹ School of Medicine, Johns Hopkins University, Baltimore, MD, USA

² Department of Neurology, Georgetown University, Washington DC, USA

*corresponding author, jmurter1@jhu.edu

Introduction

The cerebellum's role in language processing in primary progressive aphasia (PPA) remains unclear. Although the right cerebellum is known to support both language and cognitive functions (e.g., Desmond & Fiez, 1998; Keren-Happuch et al., 2014; Mariën, 2017), little is known about its functional connections with bilateral cortical hemispheres in PPA. Our previous research demonstrated that connections between the right cerebellum and the residual cerebral hemispheres can predict naming ability in chronic poststroke aphasia (Stilling et al., 2025). This study explored the cerebello-cerebral resting-state functional connectivity (FC) across the three PPA variants. In addition, we also assessed how naming severity influences this connectivity as anomia is common to all the three PPA variants.

Methods

We studied 32 individuals with PPA [12 with logopenic variant PPA (lvPPA), 11 with nonfluent agrammatic PPA (nfaPPA), and 9 with semantic variant PPA (svPPA); mean age = 68.19 ± 7.73 years; 19 females]. Participants were classified using consensus criteria for each variant (Gorno-Tempini et al., 2011). Participants completed detailed language assessments, including the Boston Naming Test (BNT, Kaplan et al., 2001). Resting-state fMRI (rsfMRI) scans were acquired using a 3T scanner as part of a clinical trial (NCT02675270). Imaging data were preprocessed and analyzed using CONN toolbox in MATLAB (Whitfield-Gabrieli & Nieto-Castanon, 2012).

We conducted regions of interest (ROI-to-ROI) analyses to examine FC between the right cerebellar Crus I/II (seed ROIs: Cereb1r/Cereb2r), bilateral Crus 7 and 8, and bilateral cortical language areas: middle frontal gyrus (MidFG), inferior frontal gyrus (IFG) pars opercularis and triangularis, anterior/posterior superior temporal gyrus (STG), anterior/posterior middle temporal gyrus (MTG), anterior/posterior inferior temporal gyrus (ITG), angular gyrus (AG), and anterior/posterior supramarginal gyrus (SMG). We performed group-level FC analysis. We also included naming severity (BNT scores) as a covariate. A multivariate pattern analysis (MVPA) cluster-level FDR correction at $p < 0.05$ and a connection-level threshold of $p < 0.05$ (uncorrected) were applied. Results were compared to 25 cognitively normal right-handed participants (mean age 63 ± 9.63; 11 females) from Stilling et al. (2025).

Results

In controls, the cerebellar seed regions showed FC with bilateral fronto-temporo-parietal language regions (Figure 1a). In PPA, positive FC was observed between the right

cerebellar Crus I/II (Cereb1r/Cereb2r) and other cerebellar regions. FC was also observed between the right cerebellar Crus I/II and left MidFG, anterior/posterior ITG, and anterior/posterior MTG. A negative correlation was found with the left anterior STG and right IFG (Figure 1b). After controlling for naming severity, only one significant connection remained—between the right cerebellum Crus II and left posterior ITG.

Conclusion

These preliminary findings suggest preserved, although reduced, cerebello-cerebral FC in PPA compared to controls. Notably, FC between the right cerebellum and left posterior ITG persisted even after adjusting for severity of naming impairment. The ITG is a key region that is commonly associated with naming in PPA (Breining et al., 2023; Cotelli et al., 2016; Leyton et al., 2017; Meyer et al., 2017). This region remains relatively preserved in early PPA, especially in lvPPA and nfaPPA, highlighting its potential role in compensatory mechanisms.

References

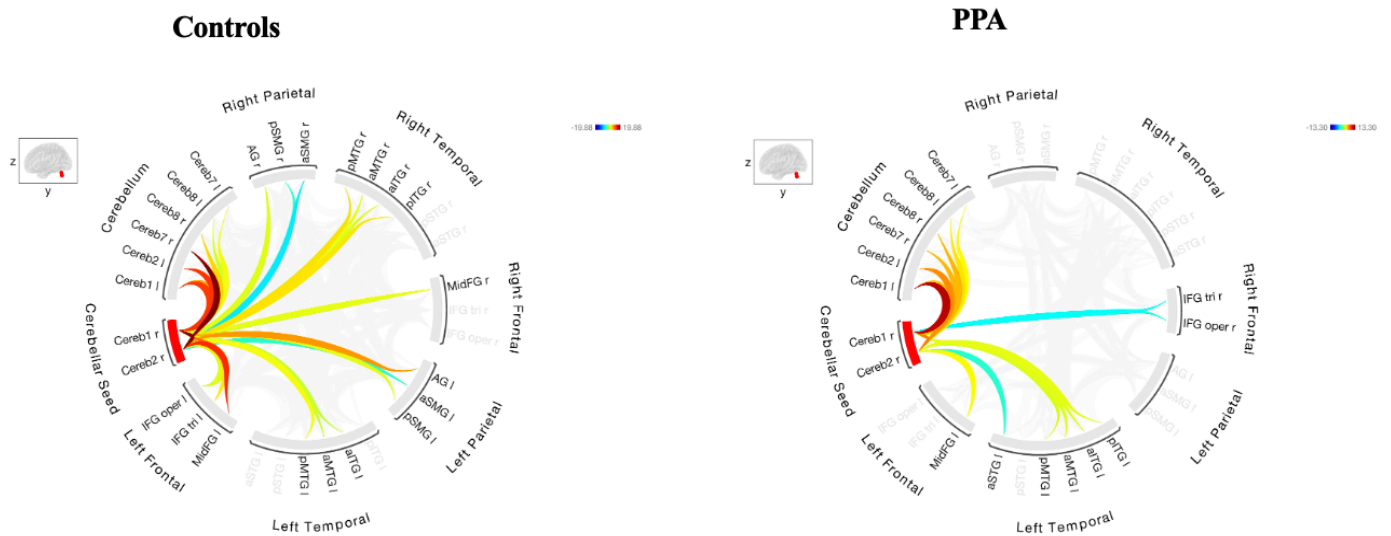
- Breining, B. L., Faria, A. V., Tippet, D. C., Stockbridge, M. D., Meier, E. L., Caffo, B., ... & Hillis, A. E. (2023). Association of regional atrophy with naming decline in primary progressive aphasia. *Neurology*, 100(6), e582-e594.
- Cotelli, M., Manenti, R., Paternico, D., Cosseddu, M., Brambilla, M., Petesi, M., ... & Borroni, B. (2016). Grey matter density predicts the improvement of naming abilities after tDCS intervention in agrammatic variant of primary progressive aphasia. *Brain topography*, 29, 738-751.
- Desmond, J. E., & Fiez, J. A. (1998). Neuroimaging studies of the cerebellum: language, learning and memory. *Trends in cognitive sciences*, 2(9), 355-362.
- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., ... & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.
- Kaplan, E., Goodglass, H., & Weintraub, S. (2001). The Boston Naming Test., 2nd edn. Austin TX: Pro-Ed.m
- Keren-Happuch, E., Chen, S. H. A., Ho, M. H. R., & Desmond, J. E. (2012). A meta-analysis of cerebellar contributions to higher cognition from PET and fMRI studies. *Human brain mapping*, 35(2), 593.
- Leyton, C. E., Hodges, J. R., Piguet, O., & Ballard, K. J. (2017). Common and divergent neural correlates of anomia in amnesic and logopenic presentations of Alzheimer's disease. *Cortex*, 86, 45-54.
- Mariën, P. (2017). A role for the cerebellum in language and related cognitive and affective functions. *Neural mechanisms of language*, 175-198.
- Meyer, A. M., Faria, A. V., Tippet, D. C., Hillis, A. E., & Friedman, R. B. (2017). The relationship between baseline volume in temporal areas and post-treatment naming accuracy in primary progressive aphasia. *Aphasiology*, 31(9), 1059-1077.
- Stilling, J., Kim, J. H., Cust, S., Keser, Z., Murter, J. L., Tippet, D. C., ... & Sebastian, R. (2025). Cerebello-Cerebral Resting-State Functional Connectivity in Poststroke Aphasia. *Brain connectivity*, 15(1), 40-54.

Whitfield-Gabrieli, S., & Nieto-Castanon, A. (2012). Conn: a functional connectivity toolbox for correlated and anticorrelated brain networks. *Brain connectivity*, 2(3), 125-141.

Acknowledgments

This work was supported by NIDCD/NIA under Grant R01DC011317.

Figure 1. Resting-state FC between the right Cerebellar Crus I/II, seed ROI with the other cerebellar and cortical ROIs in controls and participants with PPA. Warmer colors indicate increased degree of connectivity (positive correlations) and cooler colors indicate decreased connectivity (negative correlations).



Discourse Profiles in Children With and Without Aphasia: A Comparative Study of Syntactic Complexity and Communicative Content

Hema Nagaraj¹ and Pooja Chandrashekar^{1*}

¹ Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysuru, (Karnataka), India

*corresponding author, p.chshkr@gmail.com

Introduction

Discourse analysis offers critical insights into expressive language skills in children. Beyond syntactic complexity, effective communication also relies on the use of meaningful content (propositional speech) versus automatic, non-specific expressions (non-propositional speech) (Heilmann et al., 2010). Children with aphasia often struggle with both structure and content due to underlying neurological impairments. This study aimed to compare discourse features between typically developing (TD) children and a child with aphasia, all aged 5 years, using both syntactic measures and the Discourse Analysis Scale (Hema & Shyamala, 2013), which evaluates the propositional and non-propositional aspects of communication.

Methods

Conversational language samples were collected from two groups of 5-year-old children: thirty typically developing children and three children with childhood aphasia, across five sessions each. Samples were transcribed and analyzed for (1) number of T-units, (2) number of clauses, (3) mean words per clause, and (4) mean words per T-unit. The Discourse Analysis Scale was also used to code utterances as propositional (e.g., discourse structure, coherence) and non-propositional (e.g., turn taking, conversation repair).

Results

TD children demonstrated greater syntactic complexity: T-units = 26 (SD = 1.41), clauses = 32 (SD = 1.41), words/clause = 4.0 (SD = 0.73), and words/T-unit = 6.0 (SD = 0.98). The children with aphasia showed reduced complexity: T-units = 16.4 (SD = 1.02), clauses = 18.4 (SD = 1.02), words/clause = 3.1 (SD = 0.24), and words/T-unit = 3.88 (SD = 0.17). On the Discourse Analysis Scale, TD children produced a higher proportion of propositional utterances compared to the children with aphasia showing disrupted discourse structure.

Conclusions

This study highlights both structural and functional discourse impairments in a child with aphasia. Reduced syntactic complexity was accompanied by a lower proportion of propositional content, suggesting limited ability to convey meaningful, contextually relevant information. These findings reinforce the importance of using multidimensional discourse assessments—including both syntactic and propositional analyses—for comprehensive language evaluation in clinical populations. Future work should expand

to larger cohorts and explore task-specific discourse variability for diagnostic and intervention planning.

References

- Hema, N. & Shyamala, K. C. (2013). Discourse analysis in Kannada Bilingual Individuals with Traumatic Brain Injury. Submitted as a part of doctoral thesis to University of Mysore.
- Heilmann, J., Miller, J. F., Nockerts, A., & Dunaway, C. (2010). Properties of the narrative scoring scheme using narrative retells in young school-age children. *American journal of speech-language pathology*, 19(2), 154–166

The role of the right and left hemispheres in verbal fluency: evidence from bvFTD and nfvPPA

Kyriaki Neophytou, PhD^{*1}, John Papatriantafyllou, MD^{2†}, Kyrana Tsapkini, PhD^{1,3†}

¹Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, USA

²Third Age Center IASIS, Athens, Greece

³Department of Cognitive Science, Johns Hopkins University, Baltimore, MD, USA

† shared senior authorship

*corresponding author, kneophy1@jhu.edu

Introduction

The non-fluent variant of Primary Progressive Aphasia (nfvPPA) and the behavioral-variant Fronto-temporal Dementia (bvFTD) are neurodegenerative disorders primarily characterized by agrammatic and effortful speech, and by progressive deterioration in personality and social behavior, respectively (Gorno-Tempini et al., 2011; Rankin et al., 2005). The loci of brain atrophy are the frontal and temporal regions, primarily in the left hemisphere (LH) for nfvPPA and the right hemisphere (RH) for bvFTD, at least initially. A recent study on verbal fluency reported differences in performance between bvFTD, PPA and healthy control individuals (Van Den Berg et al., 2024). Prior research in PPA has shown associations of verbal fluency with the integrity of both LH and RH temporo-frontal regions (Riello et al., 2021). However, no studies have investigated the neural substrates of verbal fluency, and of language performance in general, in bvFTD. This study investigated the unique contribution of the two hemispheres in language, by studying verbal fluency in both bvFTD and nfvPPA.

Methods

Participants were 46 bvFTD Greek-speaking individuals and 32 nfvPPA English-speaking individuals. Verbal fluency was assessed using (1) Phonemic Fluency and (2) Semantic Fluency (i.e., in 1-minute, name as many words as possible (1) starting from letters with equivalent phonotactic and frequency characteristics in the two languages, i.e., the letter 'f' in English and 'π' (/p/) in Greek, and (2) from the same semantic category, i.e., 'animals'). Brain integrity was indexed with average cortical thickness for the bilateral superior (STG), middle (MTG) and inferior (ITG) temporal gyri, as well as the bilateral superior (SFG), middle (MFG) and inferior opercular (IFG-oper), orbital (IFG-orb), triangular (IFG-triang) frontal gyri.

The statistical analysis included simple linear models assessing whether for a given region, each hemisphere explains unique variance (R^2) in verbal fluency. By unique, we mean variance explained by one hemisphere, beyond what is accounted for by the contralateral hemisphere. To achieve this, for each region, we compared variance explained by both hemispheres versus by the LH or the RH, alone, to capture unique R^2 from the RH or the LH, respectively.

Results

As shown in Table 1, there is very little overlap in the regions that showed statistically significant effects across the two populations: left IFG-oper for Phonemic Fluency for both

groups, and left MFG for Phonemic Fluency and Semantic Fluency for nvPPA and bvFTD, respectively. Importantly, the only statistically significant effects for the RH were found for the nvPPA group. Specifically, the right ITG explained unique variance for both Phonemic and Semantic Fluency.

Conclusions

Evidence from nvPPA showed that, in the context of LH atrophy, only the RH temporal lobe (but not the RH frontal lobe) can successfully compensate for verbal fluency. On the other hand, evidence from bvFTD showed that in the presence of RH atrophy, the LH supports verbal fluency with both temporal (STG, MTG) and frontal areas (MFG, IFGoperc, IFGtriang). This combined evidence highlights the predominant role of the frontal and temporal LH and the compensatory role of the RH ITG in verbal fluency.

References

- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., Ogar, J. M., Rohrer, J. D., Black, S., Boeve, B. F., Manes, F., Dronkers, N. F., Vandenberghe, R., Rascovsky, K., Patterson, K., Miller, B. L., Knopman, D. S., Hodges, J. R., Mesulam, M. M., & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006–1014. <https://doi.org/10.1212/WNL.0b013e31821103e6>
- Rankin, K. P., Kramer, J. H., & Miller, B. L. (2005). Patterns of cognitive and emotional empathy in frontotemporal lobar degeneration. *Cognitive and Behavioral Neurology*, 18(1), 28–36.
- Riello, M., Frangakis, C. E., Ficek, B., Webster, K. T., Desmond, J. E., Faria, A. V., Hillis, A. E., & Tsapkini, K. (2021). Neural correlates of letter and semantic fluency in primary progressive aphasia. *Brain Sciences*, 12(1), 1.
- Van Den Berg, E., Dijkzeul, J. C. M., Poos, J. M., Eikelboom, W. S., Van Hemmen, J., Franzen, S., De Jong, F. J., Dopper, E. G. P., Vonk, J. M. J., Papma, J. M., Satoer, D., Jiskoot, L. C., & Seelaar, H. (2024). Differential linguistic features of verbal fluency in behavioral variant frontotemporal dementia and primary progressive aphasia. *Applied Neuropsychology: Adult*, 31(4), 669–677. <https://doi.org/10.1080/23279095.2022.2060748>

Acknowledgments

This work was supported by grants from the National Institutes of Health through awards R01 DC014475, R01 AG068881 and R01 AG075404 to KT. We are grateful to the participants for their unfailing commitment and interest in this study. We also thank referring physicians.

Table 1. Unique variance (R^2) explained and statistical significance (p-value) for each region of interest, per hemisphere, for nfvPPA and bvFTD. Blue and red indicate statistically significant (at $p < 0.05$) unique variance explained by the left- and right-hemisphere homologue areas, respectively.

Region	Hemisphere	nfvPPA				bvFTD			
		Phonemic Unique R^2	p- value	Semantic Unique R^2	p- value	Phonemic Unique R^2	p- value	Semantic Unique R^2	p- value
STG	left	0.102	0.087	0.084	0.119	0.143	0.008	0.144	0.011
	right	0.032	0.326	0.000	0.972	0.051	0.102	0.062	0.086
MTG	left	0.039	0.260	0.028	0.337	0.046	0.134	0.194	0.002
	right	0.048	0.212	0.070	0.134	0.001	0.815	0.058	0.085
ITG	left	0.059	0.108	0.019	0.405	0.011	0.463	0.064	0.095
	right	0.237	0.003	0.193	0.012	0.002	0.750	0.015	0.417
SFG	left	0.140	0.027	0.054	0.160	0.017	0.361	0.022	0.329
	right	0.002	0.767	0.016	0.432	0.002	0.728	0.002	0.788
MFG	left	0.144	0.029	0.044	0.234	0.069	0.069	0.116	0.024
	right	0.006	0.633	0.009	0.578	0.007	0.542	0.051	0.128
IFG- oper	left	0.285	0.001	0.131	0.029	0.084	0.046	0.063	0.100
	right	0.010	0.498	0.006	0.611	0.022	0.296	0.017	0.380
IFG-orb	left	0.016	0.475	0.002	0.825	0.001	0.792	0.011	0.496
	right	0.034	0.299	0.077	0.120	0.033	0.211	0.000	0.991
IFG- triang	left	0.112	0.069	0.032	0.331	0.104	0.025	0.102	0.033
	right	0.010	0.572	0.011	0.562	0.012	0.433	0.079	0.060

Bilingual Aphasia Outcomes of a Quasi-Experimental Study of an Adapted ECoLoGiC-Treatment

Yael Neumann^{1*}, Marion C. Leaman², and Aviva Lerman³

¹ Linguistics and Communication Disorders, Queens College, City University of New York, Queens, (NY), USA

² Department of Hearing and Speech, University of Kansas Medical Center, Kansas City, (KS), USA

³ Communication Disorders, Jerusalem Multidisciplinary College, Jerusalem, IL

*corresponding author, Yael.Neumann@qc.cuny.edu

Introduction

Conversation is essential to human connection, relationships, and daily life. For people with aphasia (PWA), however, the ability to participate in meaningful conversations is often disrupted, affecting their social interactions and overall well-being (e.g., Simmons-Mackie et al., 2014). While research has explored conversation-based interventions for monolingual PWA (e.g., Azios et al., 2021; Damico, et al., 2015; Leaman & Edmonds, 2024)—there is a notable gap in evidence for bilingual individuals (Neumann & Leaman, 2023).

Methods

This quasi-experimental study followed a pre-test/post-test single-subject design, with a follow-up six weeks post intervention, to investigate whether an established conversation treatment, ECoLoGiC-Treatment (Leaman & Edmonds, 2024) could be effectively adapted for bilingual PWA.

Participants included P1, a 70-y.o., Hebrew-English bilingual with moderate Broca's aphasia. He acquired English (L2) in his early 30s. P2 was a 73-y.o., Yiddish-English bilingual with mild Anomic aphasia, who began acquiring English (L2) at age 6 upon starting school.

A battery of standardized tests for language, functional communication, and patient/family-reported outcome measures (P/FROMs) was used. Treatment consisted of 20 hours of bilingually-adapted ECoLoGiC-Tx over 10 weeks. Bilingual adaptations encouraged codeswitching, supported translanguaging, and accepted language-mixing. Additionally, cross-linguistic stimulation and flexibility in language choice throughout the therapy protocol was allowed. Participants also led the choice of language used in conversations and therapy was based on culturally appropriate discourse which incorporated individual language histories and community-specific norms. Fidelity checklists for assessment and treatment protocols, and inter-rater reliability of data analysis indicated high consistency across ratings.

Results (see Table 1 for all data)

P1

For English, Language Quotient (LQ) scores from the WAB-R (Kertesz, 2006) showed clinically meaningful and statistically significant improvement at maintenance. BAT (Paradis, 1987) scores, for both languages, showed improvements across multiple subtests that were not directly targeted during therapy.

Functional Communication (CADL-3) (Holland et al., 2018) and Patient-Family Reported Outcome Measures (P/FROMs) demonstrated significant improvement and/or clinically meaningful change from baseline to post-treatment and maintenance.

P2

For English, LQ scores from the WAB-R showed clinically meaningful and statistically significant improvement at maintenance. BAT scores, for both languages, showed clinically meaningful changes across multiple subtests.

Meaningful improvement occurred for functional communication (CADL-3) and for 2/4 P/FROMs at post-treatment and maintenance.

Conclusions

Findings highlight the broad cross-linguistic benefits of holistic, culturally-sensitive, conversation-based bilingual-adapted ECoLoGiC-Tx for bilingual PWA. This indicates that for bilingual individuals, intervention encouraging spontaneous use of the entire linguistic repertoire at a conversational-level can result in widespread improved communication outcomes across the system for both languages.

References

- Azios, J. H., Archer, B., & Lee, J. B. (2021). Detecting behavioural change in conversation: Procedures and preliminary data. *Aphasiology*, 35(7), 961–983. <https://doi.org/10.1080/02687038.2020.1812031>
- Breitenstein, C., Hilari, K., Menahemi-Falkov, M., Rose, M. L., Wallace, S. J., Brady, M. C., Hillis, A. E., Kiran, S., Szaflarski, J. P., Tippet, D. C., Visch-Brink, E., & Wilmes, K. (2023). Operationalising treatment success in aphasia rehabilitation. *Aphasiology*, 37(11), 1693–1732. <https://doi.org/10.1080/02687038.2021.2016594>
- Damico, J., Tetnowski, J., Lynch, K., Hartwell, J., Weill, C., Heels, J., & Simmons-Mackie, N. (2015). Facilitating authentic conversation: An intervention employing principles of constructivism and conversation analysis. *Aphasiology*, 29(3), 400–421. <https://doi.org/10.1080/02687038.2014.945388>
- Holland, A. L., Wozniak, L., & Fromm, D. (2018). *Communication Activities of Daily Living—Third Edition: CADL-3*. Austin, TX: Pro-Ed.
- Hula, W. D., Donovan, N. J., Kendall, D. L., & Gonzalez Rothi, L. J. (2010). Item response theory analysis of the Western Aphasia Battery. *Aphasiology*, 24(11), 1326–1341. <https://doi.org/10.1080/02687030903422502>
- Hula, W. D., & Doyle, P. J. (2021). The Aphasia communication outcome measure: Motivation, development, validity evidence, and interpretation of change scores. *Seminars in Speech and Language*, 42(3), 211–224. <https://doi.org/10.1055/s-0041-1730906>
- Kertesz, A. (2006). *Western Aphasia Battery – Revised*. Psychological Corporation.
- Palmer, R., Dimairo, M., Cooper, C., Enderby, P., Brady, M., Bowen, A., Latimer, N., Julious, S., Cross, E., Alshreef, A., Harrison, M., Bradley, E., Witts, H., & Chater, T. (2019). Self-managed, computerised speech and language therapy for patients with chronic aphasia post-stroke compared with usual care or attention control (Big CACTUS): A multicentre, single- blinded, randomised controlled trial. *The Lancet Neurology*, 18(9), 821–833. [https://doi.org/10.1016/S1474-4422\(19\)30192-9](https://doi.org/10.1016/S1474-4422(19)30192-9)

- Leaman, M. C., & Edmonds, L. A. (2024). *Pilot results for ECoLoGiC-Tx: A new conversation-level intervention improving language in people with moderate to severe aphasia*. *American Journal of Speech-Language Pathology*, 33, 153-172.
- Neumann, Y. & Leaman, M.C. (2023). *Conversation Treatment in Aphasia in Monolingual and Multilingual Adults*. In M. Goral & A. Lerman (Eds.) *Advances in the Neurolinguistic Study of Multilingual and Monolingual Adults: In honor of Professor Loraine K. Obler*. (pp. 186-200). Routledge.
- Palmer, R., Dimairo, M., Cooper, C., Enderby, P., Brady, M., Bowen, A., Latimer, N., Julious, S., Cross, E., Alshreef, A., Harrison, M., Bradley, E., Witts, H., & Chater, T. (2019). Self-managed, computerised speech and language therapy for patients with chronic aphasia post-stroke compared with usual care or attention control (Big CACTUS): A multicentre, single- blinded, randomised controlled trial. *The Lancet Neurology*, 18(9), 821–833. [https://doi.org/10.1016/S1474-4422\(19\)30192-9](https://doi.org/10.1016/S1474-4422(19)30192-9)
- Paradis, M., & Libben, G. (1987). *The assessment of bilingual aphasia*. Lawrence Erlbaum Associates, Inc.
- Simmons-Mackie N, Savage MC, Worrall L. (2014). Conversation therapy for aphasia: A qualitative review of the literature. *International Journal of Language and Communication Disorders*, 49(5), 511-526.

Table 1. Results from the formal language, functional communication and patient/family outcome measures and control task.

Measures	P1			P2		
	Baseline	Post-Treatment	Maintenance	Baseline	Post-Treatment	Maintenance
WAB-R:						
AQ (/100)	55.8	50.6	52.9	86.5	86.6	89.6
LQ (/100)	46.5	44.1	59*	72.7	70.3	80.4
WAB-R subtests:						
Information content (/10)	8	8	8	9	9	10
Fluency (/10)	5	4	4	9	9	9
Spontaneous speech (/20)	13	12	12	18	18	19
Auditory verbal comprehension (/10)	6.4	6.8	7.6	8.9	8.6	9
Repetition (/10)	4.7	3.6	3.7	7.9	7.2	7.8
Naming and word finding (/10)	3.8	2.9	3.2	8.5	9.5	9
Reading (/100)	52	58	74	80	76	81
Writing (/100)	41	36	51	67	59	52
BAT-English-Screening subtests:						
Spontaneous speech (/30)	12	17	16	25	24	25
Auditory verbal discrimination (/7)	7	3	4	6	6	7
Syntactic comprehension (/10)	6	7	6	3	7	5
Repetition of words and nonsense words (/12)	2	7	6	10	10	12
Repetition of sentences (/3)	0	1	0	2	3	3
Series (/2)	1	2	2	2	2	2
Verbal fluency (/2)	1	2	2	2	2	2
Semantic opposites (/5)	0	2	1	5	4	5
Reading (/9)	9	9	9	9	9	8
Copying (/2)	1	2	2	2	2	2
Reading comprehension of words (/4)	4	4	3	4	4	4

Reading comprehension for sentences (/4)	4	4	4	2	4	4
Naming (/6)	1	5	4	6	6	6
Pointing (/5)	3	4	5	5	5	5
Simple and semi complex commands (/6)	2	4	4	6	6	5
Complex commands (/3)	3	0	0	0	1	2
Dictation (/3)	1	1	1	2	1	2
BAT-Hebrew-Screening subtests:				BAT-Yiddish-Screening subtests:		
Naming (/6)	5	3	4	5	5	5
Pointing (/5)	5	3	5	5	5	5
Simple and semi-complex commands (/6)	6	4	6	6	6	6
Complex commands (/3)	0	0	1	1	2	2
Spontaneous speech (/25)	11	16	16	16	16	16
Verbal auditory discrimination (/6)	5	6	5	6	6	6
Syntactic comprehension (/10)	3	7	7	5	8	7
Repetition of words and nonsense words (/24)	17	15	17	7	14	10
Repetition of sentences (/3)	0	1	0	2	3	3
Series (/2)	0	1	1	2	2	2
Verbal fluency	1 word	1 word	0 word	2 words	2 words	2 words
Semantic opposites (/5)	0	0	1	5	4	4
Reading words (/5)	4	5	5	4	5	5
Reading sentences (/5)	3	3	3	3	2	4
Copying (/2)	1	2	2	2	1	2
Dictation (/3)	0	0	1	1	1	2
Reading comprehension of words (/4)	4	4	4	3	3	4
Reading comprehension of sentences (/4)	1	1	3	1	2	0
CADL-3 (/100)	51	74	75	79	90	91

ACOM: T-score estimate	43.5	43.23	36.93	59.6	66.8	57
CCRSA (/1000)	440	630	490	550	480	510
CETI: Mean	12	34	34	68.8	92.1	82.5
ASHA-FACS: Overall Communication Independence Mean Score	2	4.8	4.3	6.5	6.8	5.9
ALA-2 (/152)	62	n/a	n/a	113	n/a	n/a
Control: PALPA Subtest 8: Nonword repetition (/30)	1	1	5	15	15	18

Note: **Green** indicates change was deemed meaningful if the score exceeded a 10% criterion (Palmer et al., 2019). For the **WAB-R AQ** score, for P1, a change exceeding 1.8 points, and for P2, a change exceeding 4.1 points, was deemed clinically meaningful (Hula et al., 2010). For **CADL-3**, change was clinically meaningful if the score exceeded 4 points Standard Error of Measurement (SEM) and was *statistically significant for the Minimal Detectable Change Criteria (MDC90) of 9.3 points. For the **ACOM**, a clinically meaningful change exceeded 4.8 points (Hula & Doyle, 2021). indicates clinically meaningful improvement (exceeding the 10% threshold based on Palmer et al., 2019). For the **CETI**, a clinically meaningful change= 3.84; statistically significant exceeded 8.91 points (Breitenstein et al., 2023).

Red indicates clinically meaningful decline, using criteria noted above.

Asterisks (*) denote statistically significant changes.

Mediating Influence of Psycholinguistic Predictors on Spelling and Reading Performance in Primary Progressive Aphasia

Katlyn Nickels^{1*} and Aneta Kielar¹

¹ Department of Speech, Language, and Hearing Sciences, University of Arizona, Tucson, (Arizona), United States

*corresponding author, katlynnnickels@arizona.edu

Introduction

Individuals with the logopenic and nonfluent variants of primary progressive aphasia (lvPPA and nfvPPA, respectively) often experience reading and writing difficulty as a result of damage to the left perisylvian network that supports sub-lexical phonological processing (Henry et al., 2016). In addition to the status of underlying language skills such as phonology, the psycholinguistic properties of words (e.g., frequency, imageability, orthographic length) have also been shown to influence written language performance in PPA (Neophytou et al., 2019; Patterson et al., 2006; Sepelyak et al., 2011; Woollams et al., 2007). In this study, we examined how semantics, phonology and the psycholinguistic properties of words influence spelling and reading in PPA.

Methods

Twenty-one individuals with a confirmed diagnosis of lvPPA ($n=17$) or nfvPPA ($n=4$) and 21 neurotypical controls performed comprehensive language assessment that included spelling and reading of words with regular or irregular sound-letter correspondences (matched sets of stimuli) from the Arizona Battery for Reading and Spelling (Beeson et al., 2010).

A Principal Component Analysis with varimax rotation was conducted to derive factors representing phonological, semantic, and phonology-orthography transcoding skills. These factor scores were entered into multiple linear regressions to determine the degree to which these skills predicted performance on spelling and reading accuracy for regular and irregular words.

The psycholinguistic properties of real word stimuli (frequency, familiarity, age of acquisition (AoA), phonological and orthographic length, #syllables and #letters, phonological, semantic, and orthographic neighborhood densities, imageability, valence, and arousal) were extracted at the item-level and entered as predictors of spelling and reading accuracy in stepwise linear regression analyses. Mediation analyses were also conducted to explore the mediating role of psycholinguistic variables on the relationship between semantics and phonology and spelling of regular and irregular words.

Results

A repeated measures ANOVA for spelling and reading revealed a significant regularity effect (regular words > irregular words) in the PPA group but not in the neurotypical controls. Spelling of regular words was predicted by both phonology and semantics, but only semantics predicted spelling of irregular words. Models for reading were not significant.

As shown in Table 1, semantic neighborhood density was a significant predictor of regular word spelling accuracy, and frequency and imageability predicted performance on irregular words. Predictors of regular word reading accuracy included age of acquisition, phonological length, and imageability. Valence was the only predictor of irregular word reading performance. Semantic neighborhood density mediated the relationship between semantics, phonology, and regular word spelling accuracy (Figure 1), whereas imageability mediated the relationship between semantics and irregular word spelling accuracy.

Conclusions

The results of this study contribute to the understanding of language processes underlying spelling and reading performance in lvPPA and nvPPA. Specifically, we provide insights regarding the differential influence of phonological and semantic abilities on written language in PPA, and we highlight the mediating role of the psycholinguistic properties of linguistic stimuli in spelling and reading performance.

References

- Beeson, P. M., Rising, K., Kim, E. S., & Rapcsak, S. Z. (2010). A treatment sequence for phonological alexia/agraphia. *Journal of Speech, Language, and Hearing Research*, 53(2), 450–468.
- Henry, M. L., Wilson, S. M., Babiak, M. C., Mandelli, M. L., Beeson, P. M., Miller, Z. A., & Gorno-Tempini, M. L. (2016). Phonological processing in primary progressive aphasia. *Journal of Cognitive Neuroscience*, 28(2), 210–222.
- Neophytou, K., Wiley, R. W., Rapp, B., & Tsapkini, K. (2019). The use of spelling for variant classification in primary progressive aphasia: Theoretical and practical implications. *Neuropsychologia*, 133, 107157.
- Patterson, K., Ralph, M. A. L., Jefferies, E., Woollams, A., Jones, R., Hodges, J. R., & Rogers, T. T. (2006). “Presemantic” cognition in semantic dementia: Six deficits in search of an explanation. *Journal of Cognitive Neuroscience*, 18(2), 169–183.
- Sepelyak, K., Crinion, J., Molitoris, J., Epstein-Peterson, Z., Bann, M., Davis, C., Newhart, M., Heidler-Gary, J., Tsapkini, K., & Hillis, A. E. (2011). Patterns of breakdown in spelling in primary progressive aphasia. *Cortex*, 47(3), 342–352.
- Woollams, A. M., Ralph, M. A. L., Plaut, D. C., & Patterson, K. (2007). SD-squared: On the association between semantic dementia and surface dyslexia. *Psychological Review*, 114(2), 316.

Acknowledgments

We would like to thank our participants with PPA and their families for volunteering their time to participate in this study. This work was supported by the following grants to Aneta Kielar: The Arizona Alzheimer’s Consortium Grant, The Arizona Department of Health Services (ADHS) and the state of Arizona (ADHS Grant No. CTR057001); The Arizona Alzheimer’s Disease Research Center (P30AG072980); Innovations in Healthy Aging: Grand Challenges of Aging Seed Grant, The University of Arizona Health Sciences (2259304); and Data Science Academy–Transdisciplinary Research in Principles of Data Science at The University of Arizona (2259910).

Figure 1. (A) Mediation model with semantics as the predictor, semantic neighborhood density (SND) as the mediator, and regular spelling accuracy as the outcome; (B) Mediation model with phonology as the predictor, semantic neighborhood density (SND) as the mediator, and regular spelling accuracy as the outcome; (C) Mediation model with semantics as the predictor, frequency and imageability as the mediators, and irregular spelling accuracy as the outcome.

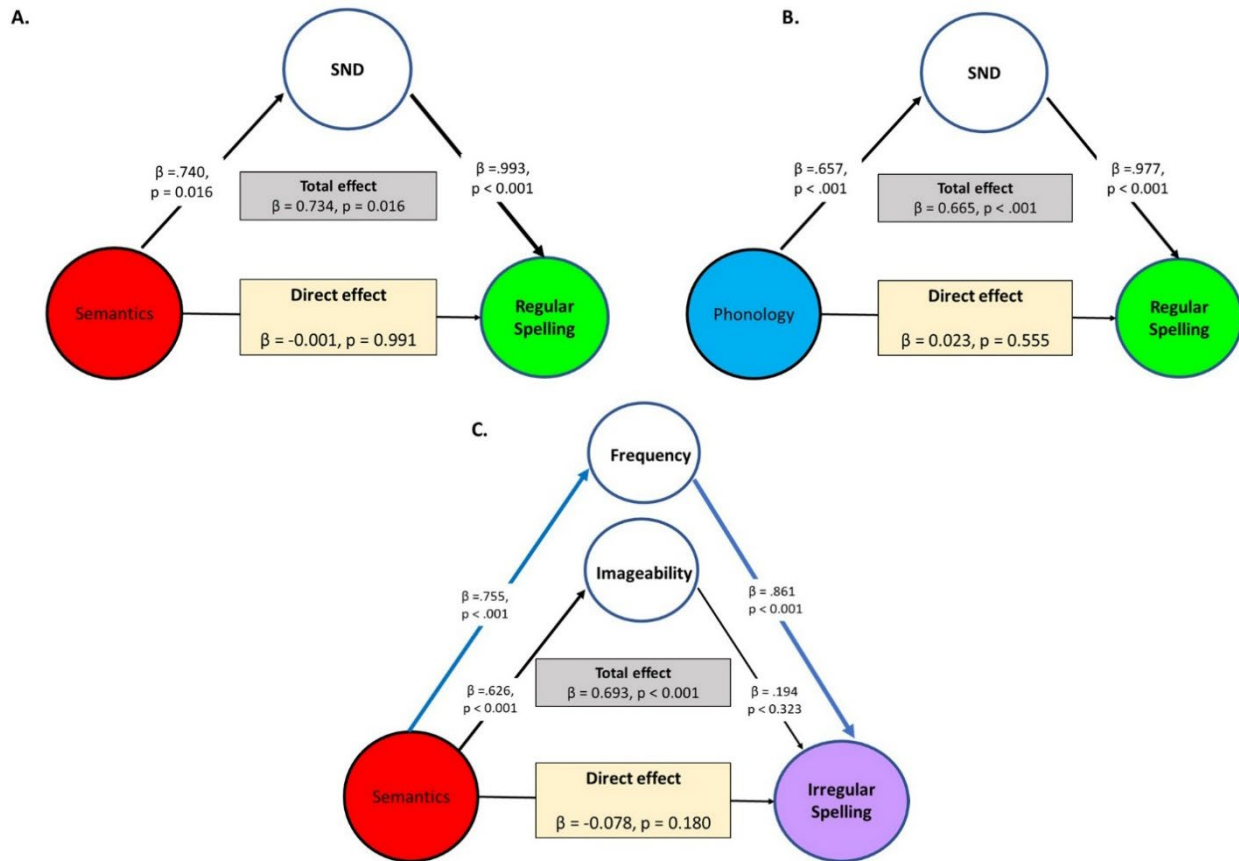


Table 1. Results of multiple linear regression analyses predicting the relative contribution of semantic, phonological, and phonology-orthography transcoding factors on single-word spelling and reading performance for regular and irregular words.

Spelling						
Regular Words						
Predictor	<i>B</i>	<i>SE</i>	β	<i>df</i>	<i>t</i>	<i>p</i>
Semantic Neighborhood Density	115.456	27.112	0.789	12	4.259	0.001
Irregular Words						
Predictor	<i>B</i>	<i>SE</i>	β	<i>df</i>	<i>t</i>	<i>p</i>
Frequency	21.763	4.327	0.747	15	5.029	<.001
Imageability	7.912	2.170	0.542	15	3.647	0.003
Reading						
Regular Words						
Predictor	<i>B</i>	<i>SE</i>	β	<i>df</i>	<i>t</i>	<i>p</i>
Age of Acquisition	-2.711	0.463	-0.802	10	-5.854	0.001
Phonological Length	-2.906	0.932	-0.419	10	-3.120	0.017
Imageability	1.122	0.376	0.387	10	2.988	0.020
Irregular Words						
Predictor	<i>B</i>	<i>SE</i>	β	<i>df</i>	<i>t</i>	<i>p</i>
Valence	16.628	7.244	0.537	14	2.296	0.039

How “healthy” is the unaffected hemisphere? Linking structural changes to language in people with gliomas

Effy Ntemou^{1*}, Thomas Picht², and Katharina Faust¹

¹Department of Neurosurgery, Heinrich Heine University, Düsseldorf, Germany

²Department of Neurosurgery, Charité Medical University Berlin, Berlin, Germany

*corresponding author, effrosyni.ntemou@med.uni-duesseldorf.de

Introduction

The concept of tumor-induced global brain network disruption provides a potential explanation for the heterogeneity observed in cognitive outcomes among individuals with gliomas (Kohli et al., 2024). This idea posits that gliomas impact broader cerebral networks, extending beyond local damage to influence even the contralateral hemisphere. Research using resting-state functional Magnetic Resonance Imaging has shown that glioma growth disrupts resting-state networks in contralateral regions, suggesting widespread effects (Stoecklein et al., 2020). Studies on structural changes in the non-affected hemisphere indicate that glioma growth can lead to cortical thinning, but may also trigger compensatory mechanisms by means of cortical thickening, highlighting the brain's plasticity and adaptability (Almairac et al., 2018; Kinno et al., 2020). As a result, the precise nature of these structural alterations and their association with cognitive changes remains unclear.

Methods

This study employs cortical thickness and surface-based morphometry to evaluate cortical network-wide effects of gliomas on brain structure and language. Preliminary analyses were conducted using preoperative language assessments and T1 MPRAGE anatomical scans from 24 left-hemisphere primary glioma patients and 15 age- and sex-matched control participants. The patient group included 17 people with high-grade gliomas (approx. 70%) and 7 with low-grade gliomas (approx. 30%). Gliomas were all located in the left hemisphere and specific tumor locations varied with most patients having gliomas affecting the temporo-insular region. Cortical thickness measures were extracted for the right, non-affected hemisphere using the Computational Anatomy Toolbox (CAT12; Gaser et al., 2024). Language comprehension and production were preoperatively assessed using the Aachen Aphasia Test (Huber et al., 1984).

Results

Preliminary findings revealed that the patient group exhibited significantly decreased cortical thickness in the right insula, fusiform gyrus, anterior temporal lobe, and motor cortex compared to the control group (Figure 1a). We did not identify any regions where the patient group exhibited increased cortical thickness compared to the control group. Spearman correlations showed that reduced cortical thickness in the right insula and fusiform gyrus was associated with poorer language comprehension abilities in glioma patients (Figure 1b). On the contrary, language production abilities were not associated with the cortical thickness of the contralateral hemisphere.

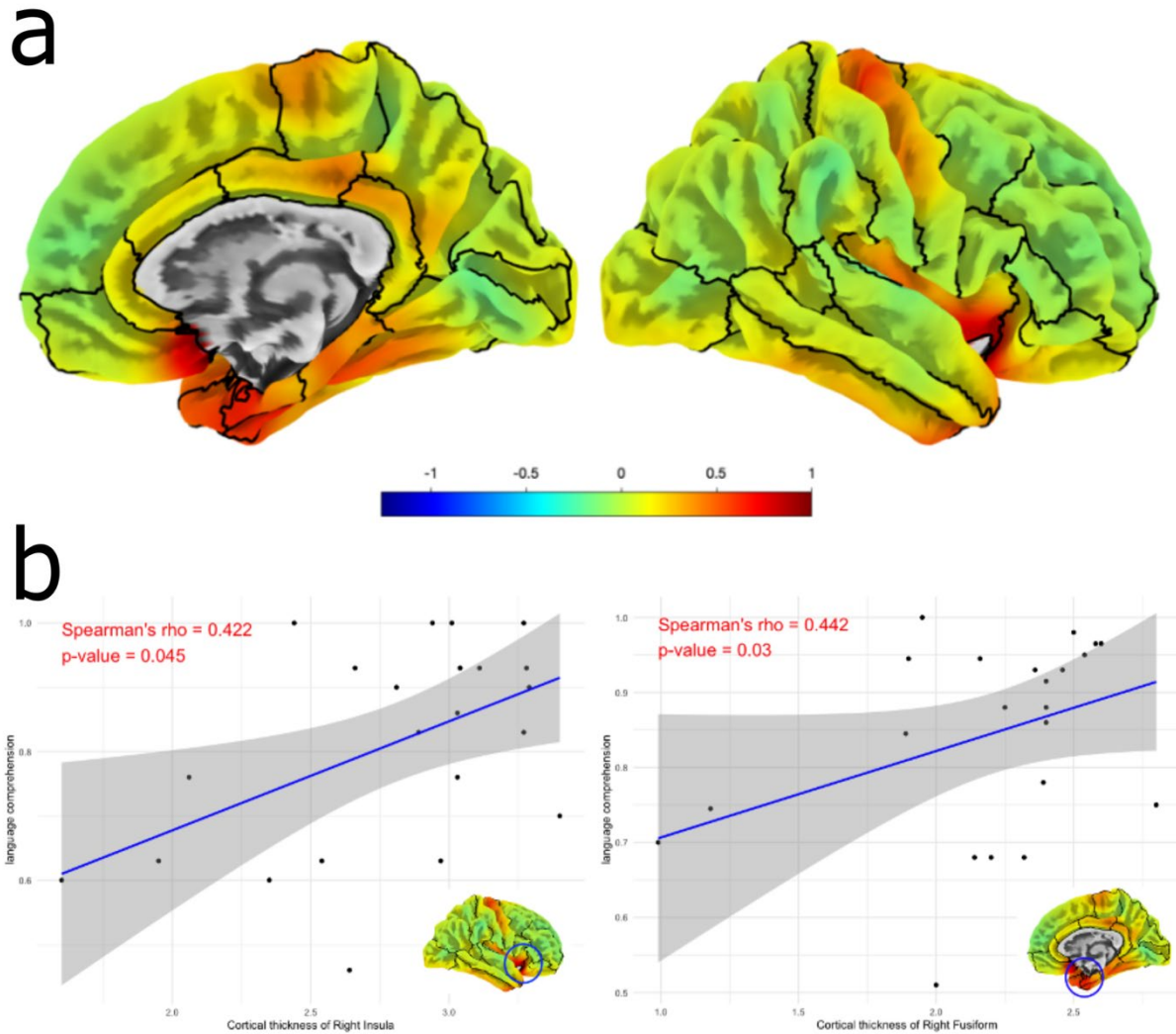
Conclusion

The preliminary results of the present study suggest that primary gliomas induce significant cortical changes in the non-affected hemisphere and that these changes are associated with language comprehension abilities. Specifically, reduced cortical thickness in regions contralateral to the areas with the greatest tumor overlap is associated with lower comprehension scores. In comparison to previous studies, we did not identify any regions with increased cortical thickness in the non-affected hemisphere of the patient cohort compared to the control group; we only observed regions that exhibited cortical thinning. These findings underscore the importance of considering global brain network disruption in understanding the cognitive impact of gliomas. By expanding this research to include a larger patient cohort, cortical and subcortical structural variables, and longitudinal behavioral measures, we can develop more precise prognostic indicators and personalized treatment strategies for individuals with gliomas.

References

- Almairac, F., Duffau, H., & Herbet, G. (2018). Contralesional macrostructural plasticity of the insular cortex in patients with glioma: A VBM study. *Neurology*, 91(20). <https://doi.org/10.1212/WNL.00000000000006517>
- Desikan, R. S., Ségonne, F., Fischl, B., Quinn, B. T., Dickerson, B. C., Blacker, D., Buckner, R. L., Dale, A. M., Maguire, R. P., Hyman, B. T., Albert, M. S., & Killiany, R. J. (2006). An automated labeling system for subdividing the human cerebral cortex on MRI scans into gyral based regions of interest. *NeuroImage*, 31(3), 968–980. <https://doi.org/10.1016/j.neuroimage.2006.01.021>
- Gaser, C., Dahnke, R., Thompson, P. M., Kurth, F., Luders, E., & the Alzheimer's Disease Neuroimaging Initiative. (2024). CAT: a computational anatomy toolbox for the analysis of structural MRI data. *GigaScience*, 13, giae049. <https://doi.org/10.1093/gigascience/giae049>
- Huber, W., Poeck, K., & Willems, K. (1984). The Aachen aphasia test. *Adv. Neurol.*, 42, 291–303.
- Kinno, R., Muragaki, Y., Maruyama, T., Tamura, M., Tanaka, K., Ono, K., & Sakai, K. L. (2020). Differential Effects of a Left Frontal Glioma on the Cortical Thickness and Complexity of Both Hemispheres. *Cerebral Cortex Communications*, 1(1), tgaa027. <https://doi.org/10.1093/texcom/tgaa027>
- Kohli, J. S., Reyes, A., Hopper, A., Stassenko, A., Menendez, N., Tringale, K. R., Salans, M., Karunamuni, R., Hattangadi-Gluth, J. A., & McDonald, C. R. (2024). Neuroanatomical profiles of cognitive phenotypes in patients with primary brain tumors. *Neuro-Oncology Advances*, 6(1), vdae152. <https://doi.org/10.1093/noajnl/vdae152>
- Stoecklein, V. M., Stoecklein, S., Galiè, F., Ren, J., Schmutzer, M., Unterrainer, M., Albert, N. L., Kreth, F.-W., Thon, N., Liebig, T., Ertl-Wagner, B., Tonn, J.-C., & Liu, H. (2020). Resting-state fMRI detects alterations in whole brain connectivity related to tumor biology in glioma patients. *Neuro-Oncology*, 22(9), 1388–1398. <https://doi.org/10.1093/neuonc/noaa044>

Figure 2. (a) Differences in terms of cortical thickness for the contrast controls > patients. Red regions demonstrate stronger differences, where the patient group exhibited thinner cortex than the control group ($p < 0.001$, uncorrected). Lines over the brain surface indicate cortical region borders according to the Desikan-Killiany atlas (Desikan et al., 2006). (b) Correlation between cortical thickness values in the patient group and language comprehension measures. Cortical thickness of the right insula (left) and the right fusiform gyrus (right) is correlated with language comprehension.



Promoting Autonomy through Communication Access: A Study of Patient Reported Outcome Measure (PROM) Administration in Aphasia

Catherine A. Off^{1*}, Jenna R. Griffin-Musick¹, Victoria L. Scharp², & Danielle Fahey¹

¹ School of Speech, Language, Hearing, & Occupational Science, University of Montana, Missoula, Montana, United States of America

² Department of Communication Sciences & Disorders, Idaho State University, Pocatello, Idaho, United States of America

*corresponding author, catherine.off@umontana.edu

Introduction

People with aphasia are frequently excluded from the opportunity to report their health status and outcomes (Lapin et al., 2021). This health disparity results from the complex and abstract language typically necessary for comprehensive health reporting. Patient Reported Outcome Measures (PROMs) are standardized, psychometrically sound tools that assess and track patient perspectives of their health. While proxies are often asked to complete PROMs on behalf of patients with aphasia, evidence suggests that proxy-patient reliability is low (Williams et al., 2006; Baylor et al., 2016). Furthermore, PROMs are inherently personal; people with aphasia should have the opportunity to complete these tools with autonomy, privacy, and high accuracy. While efforts to modify and validate existing PROMs to be aphasia-friendly are underway (e.g., Hunting Pompon et al., 2018), adapting individual PROMs is time-consuming and inefficient given the number of PROMs used by clinical providers.

To begin to develop innovative methods for increasing communication accessibility for PROMs, we will investigate the range of communication techniques, strategies, and tools used by researchers when they administer PROMs to patients across aphasia profiles.

Methods

We will use a mixed-methods prospective, pre/post and longitudinal design, using a convenience sample of patients with aphasia who participate in an Intensive Comprehensive Aphasia Programs (ICAP). Researchers will administer a battery of PROMs and cognitive-linguistic outcome measures immediately before and after the ICAP and ~ 3 months post-ICAP. Assessments will be video recorded.

PROMS

1. *Communicative Participation Item Bank* (Baylor et al., 2016)
2. *Stroke and Aphasia Quality of Life Scale-39* (Hilari et al., 2009)
3. *General Health Questionnaire* (Goldberg, 1992)
4. *Patient Health Questionnaire, 8* (Kroenke et al., 2009)
5. *Modified Perceived Stress Scale* (Hunting Pompon et al, 2018)
6. *Modified University of Washington Resilience Scale* (Hunting-Pompon et al., 2024)
7. *ICAP Patient Satisfaction* (Scharp et al., 2025; unpublished)

Cognitive-Linguistic Outcome Measures

1. *Western Aphasia Battery, Revised, part 1* (Kertesz, 2006)
2. *Boston Naming Test-second edition* (Kaplan et al., 2001)
3. *The Scenario Test* (Hilari et al., 2018)
4. *Raven's Coloured Progressive Matrices* (Raven, 1978)

Data collection will include:

1. Patient outcome measure scores
2. Researchers' field notes during PROM sessions about communication techniques, strategies, tools, and patient response modality.
3. Quantitative and qualitative observational data from video recorded PROM sessions.

Nonparametric statistical analysis will evaluate changes across timepoints. Frequency analysis will quantify how often specific types of facilitative strategies or tools are used across sessions and participants. Cognitive-linguistic outcome measure scores will be linked to the frequency analysis to support interpretation. Content analysis will be used to analyze qualitative data.

Results

Participant enrollment is underway. Data collection is scheduled for May-October 2025.

Conclusions

Observational and multimodal data sources may provide insights about how researchers support patient engagement with PROMs in real-time. Field notes may offer contextual understanding of the interactional challenges and clinical decision-making processes. Video and transcript analyses allow for examination of communication behaviors across patients and timepoints. Findings may help identify which strategies are most effective at different points in recovery or in relation to aphasia profiles.

References

- Baylor, C., Oelke, M., Bamer, A., Hunsaker, E., Off, C., Wallace, S. E., ... Yorkston, K. (2016). Validating the Communicative Participation Item Bank (CPIB) for use with people with aphasia: an analysis of differential item function (DIF). *Aphasiology*, 31(8), 861–878.
- Goldberg, D. (1992). *The General Health Questionnaire* (GHQ-12). NFER-Nelson, Windsor.
- Hilari, K., Byng, S., Lamping, D. L., & Smith, S. C. (2003). Stroke and Aphasia Quality of Life Scale-39 (SAQOL-39): evaluation of acceptability, reliability, and validity. *Stroke*, 34(8), 1944–1950.
- Hilari K, Galante L, Huck A, Pritchard M, Allen L, & Dipper L. (2018). Cultural adaptation and psychometric testing of The Scenario Test UK for people with aphasia. *International Journal of Language Communication Disorders*, 53(4), 748-760.
- Hunting Pompon, R., Amtmann, D., Bombardier, C., & Kendall, D. (2018). Modifying and validating a measure of chronic stress for people with aphasia. *Journal of Speech, Language, and Hearing Research*, 61(12), 2934-2949.

- Hunting Pompon, R. (2024, May). Validation of a modified measure of resilience for aphasia. Platform presentation at the 53rd Clinical Aphasiology Conference, Waikoloa, HI.
- Kaplan, E., Goodglass, H., & Weintraub, S. (2001). *Boston Naming Test (BNT)* [Database record]. APA PsycTests.
- Kertesz, A. (2006). *Western Aphasia Battery--Revised (WAB-R)* [Database record]. APA PsycTests.
- Kroenke, K., Strine, T. W., Spitzer, R. L., Williams, J. B., Berry, J. T., & Mokdad, A. H. (2009). The PHQ-8 as a measure of current depression in the general population. *Journal of Affective Disorders*, 114(1-3), 163-173
- Lapin, B., Thompson, N., Schuster, and Katzan, I. (2021). Optimal Methods for Reducing Proxy-Introduced Bias on Patient-Reported Outcome Measurements for Group-Level Analyses. *Circulation: Cardiovascular Quality and Outcomes*, 14, e007960,
- Raven, J. C. (1978). Manual for Raven's progressive matrices and vocabulary scales. Western Psychological Services, H. K. Lewis
- Scharp, V., Off, C., & Griffin-Musick, J. (unpublished). ICAP Patient Satisfaction Tool.
- Williams, L. S., Weinberger, M., Harris, L. E., Clark, D. O., & Biller, J. (2006). Development of a stroke-specific quality of life scale. *Stroke*, 30(7), 1362–1369.

Acknowledgments

Research reported in this presentation was supported by the National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health under Award Number U01 GM152530. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

“It’s My Life to Take Care of Her”: Perspectives on Caregiving for People with Aphasia

Olivia E. Olley^{1*}, Amanda G. Prinzi¹, Chitrali R. Mamlekar¹

¹ Speech-Language Pathology Department, Misericordia University, Dallas, PA, U.S.A

***Corresponding author, olleyo@misericordia.edu**

Introduction

The Circle of Communication Partner model (Blackstone 1999) illustrates an individual’s communication network, with the innermost circle representing life-long communication partners (e.g. close family members). For people with aphasia (PwA), close family members are primary facilitators of meaningful communication and social interaction (Howe et al., 2012). They often implement communication strategies such as providing extra time or speaking in simple sentences (Mamlekar et al., 2024). Moreover, they bridge the gap between clinical settings and real-world communication. Despite the critical role of family members as communication partners, their experiences and insights are understudied (Le Dorze & Signori, 2010). As a result, a notable gap remains in understanding their challenges and communication strategies they use to support PwA. The goal was to explore lived experiences of family members (caregivers) of PwA. We focused on identifying challenges they face, strategies they use, and types of support they receive.

Methods

Semi-structured, in-depth interviews were conducted with ten caregivers. Interviews ranged from 27 minutes to 53 minutes ($M= 36.3$) to complete. All interviews were audio and video recorded through Zoom. After the interview, the recordings and accompanying transcripts were downloaded onto an encrypted flash drive. These transcripts were thoroughly reviewed for accuracy and completeness. Interpretative phenomenological analysis (IPA) (Smith et al., 1999) was completed using NVivo® software. See **Figure 1** for the sequence of study events.

Results

Participants were related to the PwA as spouses ($n=8$), children ($n=1$), and parents ($n=1$). The average number of months providing care was 46.9 months (range= 2-144 months). One (who was an SLP and Daughter) reported receiving formal training for caring for PwA. IPA produced nine major themes: 1. Managing Healthcare Responsibilities; 2. Empowering PwA and Supporting Independence; 3. Augmentative and Alternative Communication Strategies; 4. Educating Self and Expanding the Circle of Care; 5. Adapting to Changes in Relationship Dynamics; 6. Reminiscing on the Past and Appreciating the Present; 7. Communication is a Daily Hardship; 8. Supporting Caregivers Through Education, and 9. Emotional Burden and Everyday Realities of Caregivers. See **Table 1.** for themes, subthemes, and example quotes.

Conclusions

Participants reported a lack of adequate caregiver education and emphasized the urgent need for accessible information and resources. Therefore, structured caregiver education programs (such as Worrall et. al., 2016), which provide practical strategies and emotional support for caregivers, should be offered from initial points of contact with a PwA. Another key finding is participants actively support themselves by maintaining a positive outlook, educating their support networks, and focusing on the strengths and abilities that remain rather than dwelling on what has been lost. These insights highlight the importance of counseling within the scope of speech-language pathology. Speech-language pathologists should be attentive to the emotional and practical needs of caregivers (Tellis & Barone, 2016) and recognize when referrals to additional support services are necessary. Future research must prioritize the development and evaluation of structured support interventions aimed at improving caregiver well-being and communication outcomes. Such efforts are vital to improving the caregiving experience and providing comprehensive, person- and family-centered aphasia care.

References

- Blackstone, S. W. (1999). Circles of communication partners. *Augmentative Communication News*, 12, 1-2.
- Howe, T., Davidson, B., Worrall, L., Hersh, D., Ferguson, A., Sherratt, S., & Gilbert, J. (2012). 'You needed to rehab ... families as well': family members' own goals for aphasia rehabilitation. *International journal of language & communication disorders*, 47(5), 511–521. <https://doi.org/10.1111/j.1460-6984.2012.00159.x>
- Le Dorze, G., & Signori, F. H. (2010). Needs, barriers and facilitators experienced by spouses of people with aphasia. *Disability and rehabilitation*, 32(13), 1073–1087. <https://doi.org/10.3109/09638280903374121>
- Mamlekar, C.R., Dietz, A., & Shatz, R (2024). *Two People, One Journey: AAC Intervention and Communication Partner Training for Primary Progressive Aphasia*. Clinical Aphasiology Conference, Hawaii, USA
- Smith, J. A., Jarman, M., & Osborn, M. (1999). Doing interpretative phenomenological analysis. *Qualitative health psychology: Theories and methods*, 1(1), 218-240.
- Tellis, C. M., & Barone, O. R. (2016). *Counseling and interviewing in speech-language pathology and audiology*. Jones & Bartlett Learning.
- Worrall, L., Ryan, B., Hudson, K., Kneebone, I., Simmons-Mackie, N., Khan, A., ... & Rose, M. (2016). Reducing the psychosocial impact of aphasia on mood and quality of life in people with aphasia and the impact of caregiving in family members through the Aphasia Action Success Knowledge (Aphasia ASK) program: study protocol for a randomized controlled trial. *Trials*, 17, 1-7.

Acknowledgments

This study was supported by the Misericordia University Summer Undergraduate Research Fellowship (SURF) awarded to Olivia Olley.

Figure 1. Sequence of study events.

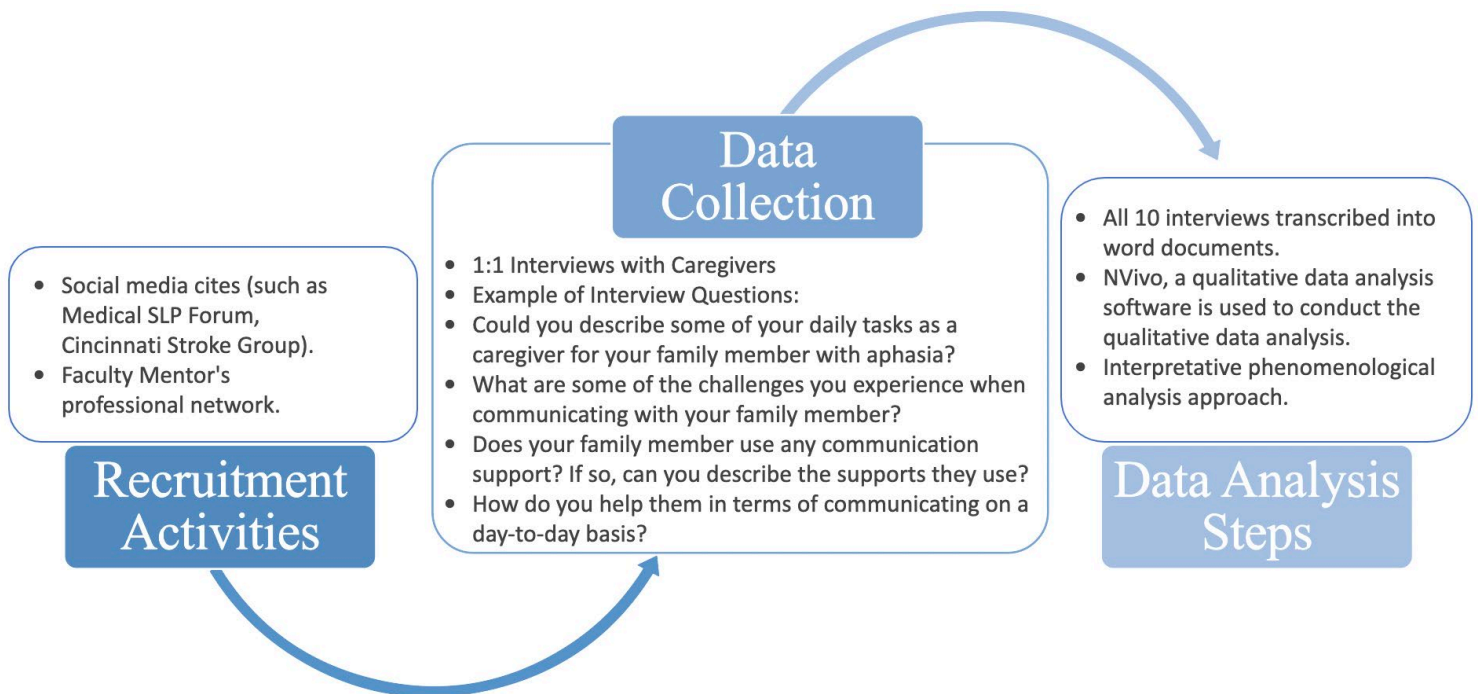


Table 1. Themes, subthemes, definitions, and participant quotes.

Theme	Definition	Example of a Quote
Managing Healthcare Responsibilities (n=10)	The ways caregivers perceive and handle the various medical and healthcare-related tasks required when caring for a loved one with aphasia.	<i>"It used to be she'd say, 'I'm going to the dentist'. Now I have to make the appointment, and I have to take her. I have to call them and make an appointment and everything. Every healthcare appointment I have to take her to and every healthcare appointment I have to make. If you can't use a phone can't [and can't] speak, so I had to do it all." [P007]</i>
Empowering Loved One with Aphasia and Supporting Independence (n=7)	Caregivers' efforts to support the autonomy and dignity of their loved ones with aphasia.	<i>"I know [the] inside of her [is] probably eating her out going through this and [I'm] careful [about] what I say to her. I don't say anything about what she's doing. I mean she'll leave the lights on or she'll put stuff out on a table and she'll leave [it] there and forget to put it back, so I have to put it back." [P002]</i>

Augmentative and Alternative Communication Strategies (n=6)	Communication aids caregivers use to enhance communication with their loved ones. and their families.	<i>"He has an iPad which he can use and we have photographs on the iPad of a variety of things that apply to things we might talk about. We have pictures of the cars. We have pictures of my daughter. We have pictures of a number of other people that we interact with so we know who we're talking about. We have pictures of places. We have [a] very short list of restaurants that we like to eat at. We have a list of doctors so that if I tell him we have to go to the doctor, I can get to that list and point to it." [P008]</i>
Educating Self and Expanding the Circle of Care (n=4) - Seeking Out Specialized Aphasia-Centered Resources - Caregivers Self-Educating	Factors caregivers emphasize while providing their loved ones with care specific to improving their deficits from aphasia.	<i>"I think it would be nice to go to a healthcare place that's directly related to caring for people with aphasia. I guess an outpatient kind of a situation where she might be able to get a little bit more help than then what she would get at speech therapy." [P010]</i>
Adapting to Changes in Relationship Dynamics (n=9)	This theme explores the shifts from spouse to caregiver and the demands in different aspects of life that come with it.	<i>"On one occasion we sat down and of course I sat next to my wife because I was gonna have to feed her and the wait person gave us the menus and she started crying because she knew how different it was. That [she] wouldn't be with the other women who are her friends because she needed me to help her eat. So there's things like that which are really very impactful on people's social life. So we go out with only people who were very comfortable with [that]. And I make an effort to make sure we do that to keep our life as normal as possible but it's really pretty hard." [P007]</i>
Reminiscing on the Past and Appreciating the Present (n=9)	The life changing experience of an aphasia diagnosis for the caregiver and person with aphasia but recognizing aspects of their life that motivate them.	<i>"I mean it's really shocking being on the other side of this. I've worked with so many stroke patients and families and help them navigate what their family member looks like now. But it's completely different when you're on the other side of it and it's your family member." [P004]</i>
Communication as a Daily Hardship (n=9)	This theme emphasizes the challenges with communication caregivers face every day, specifically referring	<i>"My husband was a PhD clinical psychologist, and our daily discussions were deep. We are both educated people. Now concepts are much more difficult for him to grasp. Even though I know he's</i>

	to their own frustrations and shifts in communication abilities following an aphasia diagnosis.	<i>understanding, his ability to express and then sometimes to receive the information, is still very, very challenging.” [P006]</i>
Supporting Caregivers Through Education (n=9)	The education that caregivers have been provided and the gaps in education for healthcare providers on aphasia care.	<i>“I never would have thought a million years that we would have to apply for social security disability, but nobody gives you any directions. It’s like a big secret. [I] wish there was a resource where “hey, yeah, what do I do in this case or what do I do in that case?” I just wish they would educate the patients more than they do and their families on what resources are out there that can help them. Because it’s stressful money-wise. It takes a toll on your life and your relationship.” [P001]</i>
Emotional Burden and Everyday Realities of Caregivers (n=6)	This theme explores caregivers’ use of advocacy for their loved one’s care and to marginalize their role while recognizing the need for validation and emotional support for caregivers.	<i>“There’s a problem because they don’t understand what the caregivers do, and what the role of the caregivers is. People always tell the providers “Well, you have to interact with the patient. Look at the patient, talk to the patient, not the person who’s with them.” [P008]</i>

Note. n= number of participants

Brain MRI Findings Among Patients Presenting With Neurological Symptoms at a Nigerian Tertiary Care Facility

Kenneth C. Oparaji¹, Darlington-Peter C. Ugoji², Victor U. Chukwu², Miracle N. Okoche¹, and Chibuike G. Okereke¹

¹Department of Physiology, Faculty of Basic Medical Sciences, Alex Ekwueme Federal University (Aefunai), P.M.B. 1010 Abakaliki, Ebonyi State, Nigeria

²David Umahi Federal University Teaching Hospital (Dufuth) Uburu, Ebonyi State, Nigeria

Introduction

In Nigeria, the burden of neurological disorders is growing, and this poses significant challenges for our frail health-care system. This informed the need for the investigation of local (African) brain MRI data to better understand these abnormalities and their pattern of presentation.

Methods

As a retrospective study, it was designed to review clinical data and MRI reports of 51 patients who presented at a tertiary health facility (DUFUTH) in Uburu, Ebonyi State, Nigeria between January 2023 and June 2024. Demography, image findings, and the relationship between the MRI findings, age, and sex were data obtained and analysed using descriptive and inferential statistics with the degree of significance set at $p < 0.05$.

Results

This study involved 25 females and 26 males, aged 0 to 95 years. About 19 (37.25%) patients had normal brain MRI findings, while 32 (62.75%) were abnormal. The most common pathologies noted were brain tumour (25.49%), followed by hydrocephalus (17.65%), and white matter diseases (13.73%). Age group 0-23 years had the highest number of pathological findings (37%); this was followed by age group 24-63 years (21%). No significant association ($P > 0.05$) was found to exist between gender and the MRI findings.

Conclusion

The most common brain MRI findings were brain tumours, hydrocephalus, and white matter diseases respectively. The study adds to existing data-sets, and also highlights common brain pathologies in a local African tertiary hospital setting which will not only offer research-based insights but also, clinical and medical perspectives.

Effect of Forced Prediction on Syntactic Priming in Neurologically Intact Middle-aged and Older Adults

Parisa Osfoori^{1*}, Chaleece W. Sandberg¹, Carrie Neal Jackson²

¹ Department of Communication Sciences and Disorders, Pennsylvania State University

² Department of Germanic and Slavic Languages and Literatures, Pennsylvania State University

*corresponding author, pvo5112@psu.edu

Introduction

Syntactic priming — the tendency to repeat recently encountered sentence structures (Bock, 1986; Pickering & Ferreira, 2008) — can be a therapeutic tool for improving sentence production and supporting recovery of impaired sentences in people with aphasia (PWA). While broadly studied in younger populations, less is known about syntactic priming in middle-aged and older adults, the most age-appropriate comparison group for understanding sentence processing in people with aphasia (PWA). Forced prediction may be a way to increase the salience of prediction errors, leading to enhanced error-based implicit learning (Grüter et al., 2021). This may be especially useful in aphasia therapy based on evidence that error-based learning may be preferable in aphasia (Middleton & Schwartz, 2012). We utilized the forced-prediction paradigm developed by Grüter et al. (2021) to examine whether engaging middle-aged and older adults in explicit predictions would lead to stronger priming effects compared to a classic repetition condition. Based on what Grüter et al. (2021) found in their L2 learners, we expected our participants to show increased priming in the explicit prediction condition.

Methods

Sixty-four neurologically intact English-native adults aged 40-91 years (M = 60) participated in a two-session experiment. They were randomly assigned to either a guessing game (GG) or control condition (CC). Both conditions used a picture-description task that focused on the alternation between prepositional object (PO) and double object (DO) dative constructions. In the GG condition, participants guessed how a virtual interlocutor ("Paul") would describe pictures before hearing the actual description (prime sentence), requiring them to predict the sentence structure before hearing it to encourage prediction errors (Figure 1. A and B). In the CC condition, they simply repeated Paul's prime sentence and then described the target pictures themselves (Figure 1.C). Both conditions included baseline, priming, immediate post-test (session1), and delayed post-test (session2) phases. Production of DO constructions between conditions was compared across the two sessions.

Results

Contrary to our expectations, mixed-effects logistic regression analysis revealed no significant differences in immediate priming or longer-term adaptation between conditions, nor significant priming effects in either the GG or CC groups (see Table 1). While not significant, the effects were numerically in the expected direction, with the GG

condition showing larger increases in DO production. Exploratory analyses found no significant correlation between age and priming effects, nor differences across task phases.

Conclusions

Several factors may account for these results. First, the explicit nature of the guessing task may have engaged declarative memory processes, potentially interfering with the implicit learning mechanisms associated with syntactic priming (Chang et al., 2012; Heyselaar et al., 2017). Second, the absence of lexical overlap between prime and target sentences may have reduced the overall priming effect. Finally, the absence of linguistic insecurity (Preston, 2013) among our native English-speakers may have diminished the effectiveness of priming task compared to the L2 learners in Grüter et al.'s (2021) study. A planned study with PWA will help elucidate whether forced prediction enhances priming in aphasia similar to the enhancement seen in L2 learners. The findings will have important implications for aphasia therapy approaches and developing treatment methods.

References

- Bock, K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, 18(3), 355–387. CIT0764.
- Chang, F., Janciauskas, M., & Fitz, H. (2012). Language adaptation and learning: Getting explicit about implicit learning. *Language and Linguistics Compass*, 6(5), 259–278.
- Grüter, T., Zhu, Y. A., & Jackson, C. N. (2021). Syntactic priming and adaptation in L2 learners: Forced prediction enhances learning. *Language Learning*, 71(3), 781–815.
- Heyselaar, E., Segaert, K., Walvoort, S. J., Kessels, R. P., & Hagoort, P. (2017). The role of nondeclarative memory in the skill for language: Evidence from syntactic priming in patients with amnesia. *Neuropsychologia*, 101, 97–105.
- Middleton, E. L., & Schwartz, M. F. (2012). Errorless learning in cognitive rehabilitation: a critical review. *Neuropsychological rehabilitation*, 22(2), 138–168.
- Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin*, 134(3).
- Preston, D. R. (2013). Linguistic Insecurity Forty Years Later. *Journal of English Linguistics*, 41(4), 304–331.
- Simmons-Mackie, N. (2018). Communication partner training in aphasia: Reflections on communication accommodation theory. *Aphasiology*, 32(10), 1215–1224.

Acknowledgments

This research was funded by the Center for Language Science (CLS) SEED grant.

Figure 1. **A:** “Paul” is introduced as a virtual interlocutor to the participant. **B:** (GG condition) sample prime trial where participant should guess how Paul described the picture before hearing the actual description (prime sentence). This required them to predict the sentence structure. **C:** (CC condition) sample prime trial where participant should repeat Paul, then describe target stimulus by themselves.

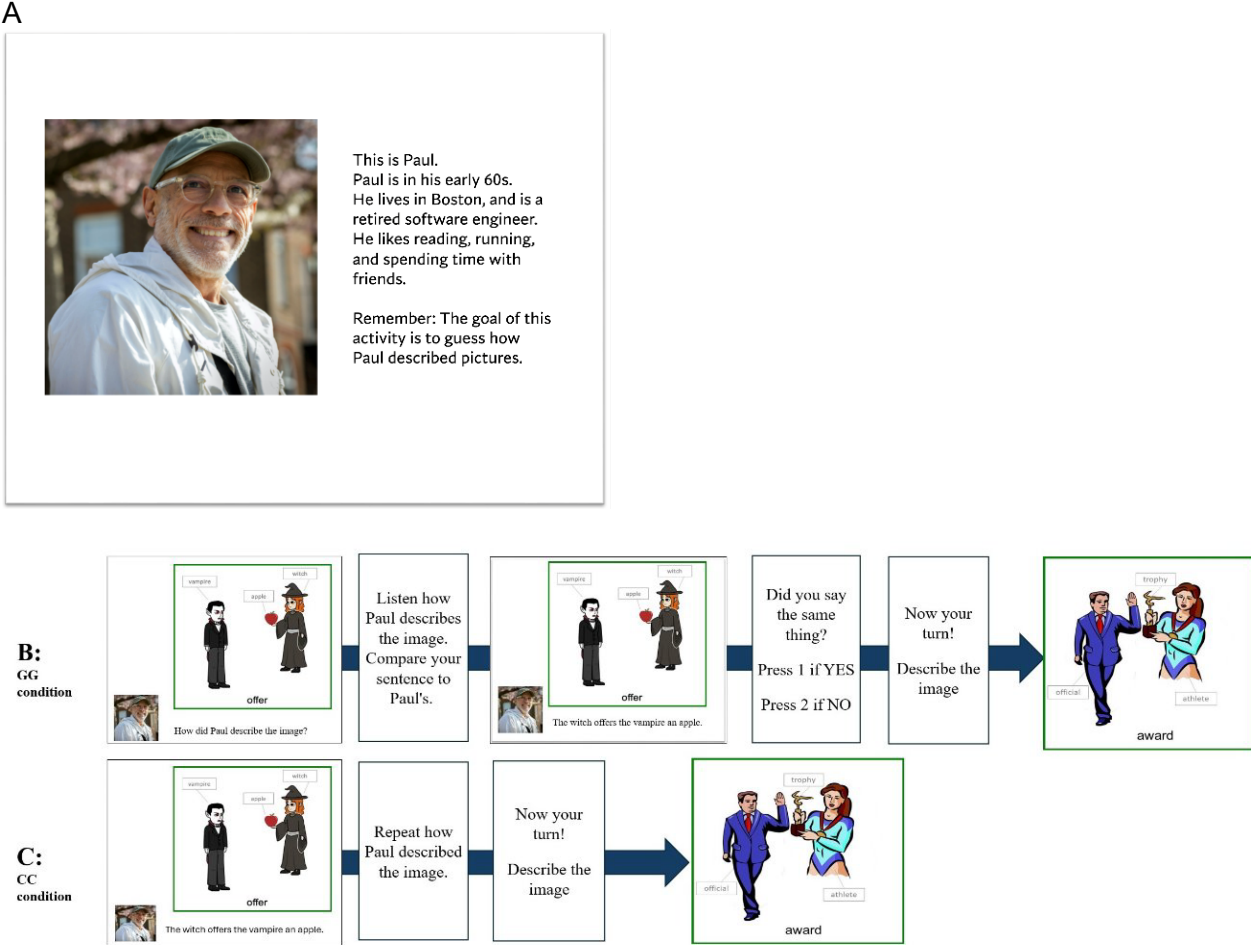
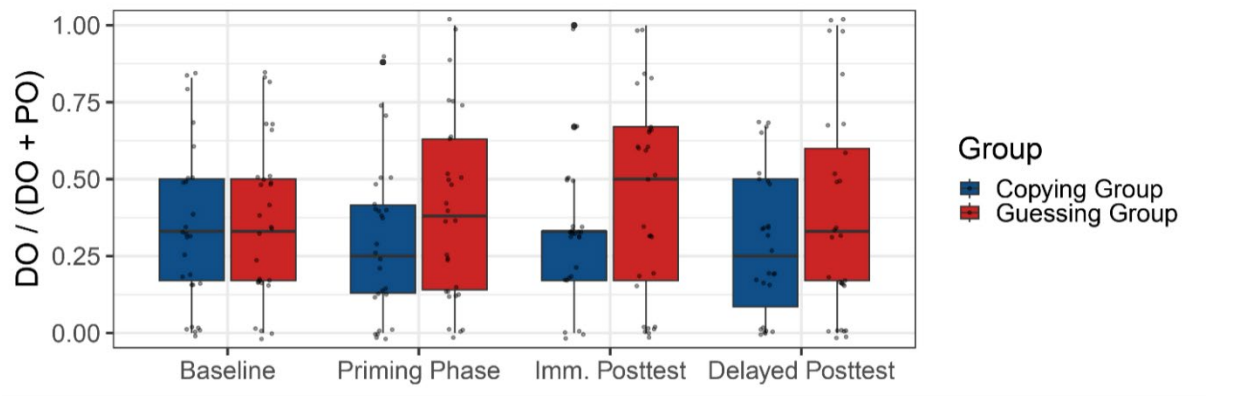


Table 1. Box and whisker plot of accuracy scores (proportion of DO constructions) by group and task phase.



Unmasking Delayed Decay and Integration Impairments in Aphasia: ERP Evidence from Masked Priming

Ashlie H. Pankonin^{1, 2*}, JoAnn P. Silkes¹

¹ School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, CA, United States

² Department of Cognitive Science, University of California, San Diego, La Jolla, CA, United States

***corresponding author, apankonin3092@sdsu.edu**

Introduction

Background: Anomia is a hallmark symptom of aphasia, yet its underlying causes remain unclear. One proposed explanation is automatic spreading activation within the language network (e.g., Dell et al., 1997) operates on an atypical time course in people with aphasia (PWA; e.g., Silkes & Rogers, 2012). However, prior studies have been unable to directly examine the time course of this implicit processing mechanism due to methodological limitations. To address this gap, we used a masked priming paradigm and event-related potentials (ERPs) to isolate implicit processing and examine the time course of automatic spreading activation in PWA.

(Masked) Priming: Priming is fundamentally due to the automatic, implicit spread of activation (e.g., de Groot, 1983; Fowler et al., 1981). However, traditional priming tasks are susceptible to explicit processing strategies. Masked priming overcomes this by rapidly presenting prime words with visual stimuli that interfere with conscious perception of the prime while still permitting unconscious lexical-semantic activation (Forster & Davis, 1984). Consequently, facilitation of target processing can be attributed to implicit mechanisms.

Event-Related Potentials (ERPs): Because spreading activation is rapid and unconscious, it is best measured using high-temporal-resolution methods like electroencephalography (EEG), which yields ERPs. We focused on the N400 ERP component, which indexes automatic semantic processing (Kiefer, 2002; Kutas & Federmeier, 2011) and reflects neural priming effects (Eddy et al., 2014; Kiefer, 2002).

Methods

Participants were 14 PWA and 13 age-matched adults with typical language (Controls). EEG was recorded while participants viewed sequentially presented prime and target words and completed a go/no-go semantic categorization task (responding to animal names). Targets were preceded by masked, visible, or no primes and were either immediate or delayed repetitions of those primes (Table 1). Critical trials consisted of non-animal word prime-target pairs with masked or visible primes that were either the same as the target (primed trials) or unrelated (unprimed trials). Prime-target intervals were manipulated to assess group differences in the time course of automatic spreading activation, indexed by N400 priming effects. To ensure effective masking, masked prime durations were individually calibrated to minimize conscious prime perception, and masking was validated with additional behavioral and ERP measures.

Results

Validation measures confirmed effective masking and task engagement. Neither group showed behavioral priming effects for repetitions of masked primes; however, ERP results revealed distinct N400 priming patterns across participant groups. Specifically, PWA showed N400 priming effects for both immediate and delayed repetitions of masked primes, whereas Controls showed priming effects only for immediate repetitions (Figure 1). Additionally, PWA exhibited equivalent priming effects for delayed repetitions of visible and masked primes, while Controls showed the typical pattern of stronger priming for visible than masked primes.

Conclusions

These findings suggest that PWA experience prolonged lexical activation due to delayed decay of activation within the language network and have difficulty integrating explicitly and implicitly processed information. Such impairments may underlie anomia. These findings also have implications for the timing of stimulus delivery in aphasia treatment and suggest that targeting the dynamics of spreading activation may support language processing deficits in aphasia.

References

- de Groot, A. M. B. (1983). The range of automatic spreading activation in word priming. *Journal of Verbal Learning and Verbal Behavior*, 22(4), 417–436. [https://doi.org/10.1016/S0022-5371\(83\)90273-6](https://doi.org/10.1016/S0022-5371(83)90273-6)
- Dell, G. S., Schwartz, M., Martin, N., Saffran, E., & Gagnon, D. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review*, 104, 801–838. <https://doi.org/10.1037/0033-295X.104.4.801>
- Eddy, M. D., Grainger, J., Holcomb, P. J., Mitra, P., & Gabrieli, J. D. E. (2014). Masked priming and ERPs dissociate maturation of orthographic and semantic components of visual word recognition in children: Masked priming and ERPs in children. *Psychophysiology*, 51(2), 136–141. <https://doi.org/10.1111/psyp.12164>
- Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 10(4), 680–698. <https://doi.org/10.1037/0278-7393.10.4.680>
- Fowler, C. A., Wolford, G., Slade, R., & Tassinari, L. (1981). Lexical access with and without awareness. *Journal of Experimental Psychology: General*, 110(3), 341–362. <https://doi.org/10.1037/0096-3445.110.3.341>
- Kiefer, M. (2002). The N400 is modulated by unconsciously perceived masked words: Further evidence for an automatic spreading activation account of N400 priming effects. *Cognitive Brain Research*, 13(1), 27–39. [https://doi.org/10.1016/S0926-6410\(01\)00085-4](https://doi.org/10.1016/S0926-6410(01)00085-4)
- Kutas, M., & Federmeier, K. D. (2011). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, 62(1), 621–647. <https://doi.org/10.1146/annurev.psych.093008.131123>
- Silkes, J. P., & Rogers, M. A. (2012). Masked priming effects in aphasia: Evidence of altered automatic spreading activation. *Journal of Speech, Language, and Hearing Research*, 55(6), 1613–1625. <https://doi.org/10.1044/1092->

Acknowledgments

We thank Maya Misra and Phil Holcomb for graciously sharing their experimental protocols. We thank Lee Osterhout, Judy McLaughlin, Mark Pettet, Diane Kendall, and Alyson Abel for their invaluable contributions to this work. Both authors contributed equally to this work. This research was supported by the National Institutes of Health [T32DC007361]; the Walter C. and Anita C. Stolov Research Fund, University of Washington Department of Rehabilitation Medicine, Seattle, WA; and the Dr. Sadanand Singh Endowed Professorship in Speech and Language Sciences, San Diego State University School of Speech, Language, and Hearing Sciences.

Figure 1. Grand average ERP waveforms at electrode CP1 for a) Controls and b) PWA elicited by unprimed targets (baseline; black), immediate repetitions of masked primes (blue), and delayed repetitions of masked primes (red). Shaded regions indicate ± 1 standard error of the mean. Vertical boxes highlight the analyzed N400 time window. Statistical significance is denoted by asterisks (***) $p < .001$; ns = not significant).

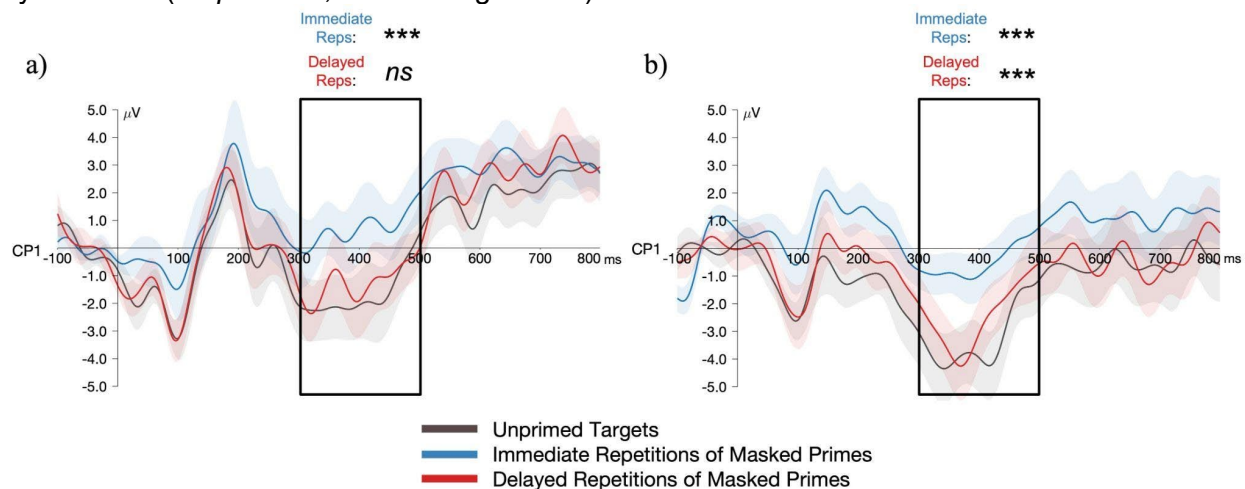


Table 1. A representative sample of a stimulus list and designation of the various stimulus conditions.

prime	TARGET	Prime Condition	Target Condition
	POUCH	blank screen	unprimed (no prime) target
harp	TWIN	masked prime	unprimed (unrelated prime) target
	MOOSE	blank screen	unprimed animal probe
posy	POSY	masked prime	primed target (immediate repetition of masked prime)
	HARP	blank screen	primed target (delayed repetition of masked prime) ^a
	POUCH	blank screen	primed target (delayed repetition of visible prime) ^a
shark	GONG	masked prime probe	filler target
	SHARK	blank screen	primed animal probe ^a

Note. Each row represents one trial, and the trials are arranged in the order they would be presented to create the stated conditions.

^a Primed animal probes and both types of delayed repetitions were pseudorandomly varied to occur from one to eight trials following their prime, with an average of four intervening trials

Cross-linguistic and cross-cultural effects on picture description in Korean and English individuals with and without aphasia

Jimin Park¹, Yae Rin Yoo¹, and Jee Eun Sung^{1*}

¹ Department of Communication Disorders, Ewha Womans University, Seoul, Republic of Korea

*corresponding author, jeesung@ewha.ac.kr

Introduction

Picture description tasks are widely used to assess connected speech in individuals with aphasia and other neurogenic communication disorders (Evans et al., 2022; MacWhinney et al., 2011; Richardson et al., 2016; Richardson et al., 2020). Standardized protocols such as the Boston Diagnostic Aphasia Examination (e.g., *Cookie Theft*) and TalkBank protocols (e.g., *Cat Rescue*) have been extensively adopted (Evans et al., 2022; MacWhinney et al., 2011; Nicholas & Brookshire, 1993; Olness et al., 2002; Sung et al., 2016). However, many of these stimuli were originally developed in Western, monolingual English-speaking contexts and may carry inherent cultural and linguistic biases that limit their applicability and interpretation in diverse populations (Steinberg et al., 2022; Stockbridge et al., 2024).

This study aims to evaluate the influence of cross-linguistic and cross-cultural factors on connected speech elicited through picture description tasks. Specifically, we use the main concept (MC) analysis to compare performance on two commonly used stimuli—*Cat Rescue* and *Refused Umbrella*—to investigate how cultural familiarity and linguistic features influence discourse production in Korean and English speakers with and without aphasia. Given that Korean is a pro-drop language that permits subject omission when referents are contextually inferable (Sohn, 2001; Sung et al., 2024), we adapted the MC scoring framework (Richardson et al., 2016) to account for such omissions. We hypothesize that group differences, despite language-adjusted scoring, may reflect the cultural specificity of the picture stimuli.

Methods

Participants

Ninety-six individuals participated: 60 controls (30 Korean-C, 30 English-C) and 36 persons with aphasia (18 Korean-PWA, 18 English-PWA). Korean-C scored within the normal range on the Korean Mini-Mental State Examination (Kang, 2006) and Seoul Verbal Learning Test (Kang et al., 2012). English-C were drawn from AphasiaBank (MacWhinney et al., 2011), age- and education-matched with Korean-C ($p=.996$, $p=.694$). Korean-PWA were diagnosed with aphasia using the Korean Western Aphasia Battery-Revised (Kim & Na, 2012) and English-PWA were selected from AphasiaBank, matched on aphasia severity ($p=.931$), age ($p=.644$), and education ($p=.306$).

Tasks

Participants described two pictures from the AphasiaBank: *Cat Rescue* (MacWhinney et al., 2011) and *Refused Umbrella* (Nicholas & Brookshire, 1993).

Analysis

Two MC scoring criteria were employed: (1) the original criteria (Richardson et al., 2016) and (2) pro-drop adjusted criteria (See Table 1). For controls, MC scores were analyzed using two-way mixed ANOVAs under each original and pro-drop adjusted criteria. For PWA, MC scores were analyzed with a two-way mixed ANOVA using the pro-drop adjusted criteria.

Results

In the original scoring, both group ($F(1,58)=36.933$, $p<.001$) and task ($F(1,58)=31.302$, $p<.001$) effects were significant, with no interaction effect ($p=.351$; Figure 1A).

Under the pro-drop adjusted scoring, both group ($F(1,58)=16.642$, $p<.001$) and task ($F(1,58)=48.469$, $p<.001$) effects were significant. Moreover, the interaction was also significant ($F(1,58)=6.830$, $p=.011$), indicating that Korean controls performed worse on the *Cat Rescue* than on the *Refused Umbrella*, unlike English controls (Figure 1B).

For PWA, only the main effect of the task was significant ($F(1,34)=15.044$, $p<.001$). Group ($p=.253$) and interaction effects were non-significant ($p=.862$; Figure 1C).

Conclusions

The current study suggests that cross-linguistic and cross-cultural differences emerged depending on the characteristics of the picture stimuli, in both controls and PWA. Even after adjusting the scoring system for cross-linguistic features like pro-drop in Korean, task-specific effects based on picture type persisted. Notably, cultural influences were particularly salient for certain stimuli, such as *Cat Rescue*. These findings highlight the importance of considering the cultural sensitivity of picture stimuli, especially when assessing individuals from diverse linguistic and cultural backgrounds.

References

- Evans, E., Coley, S. L., Gooding, D. C., Norris, N., Ramsey, C. M., Green-Harris, G., & Mueller, K. D. (2022). Preliminary assessment of connected speech and language as marker for cognitive change in late middle-aged Black/African American adults at risk for Alzheimer's disease. *Aphasiology*, 36(8), 982-1005.
- Kang, Y. (2006). A normative study of the Korean Mini-Mental State Examination (K-MMSE) in the elderly. *Korean Journal of Psychology*, 25, 1-12.
- Kang, Y., Jang, S., & Na, D. (2012). *Seoul Neuropsychological Screening Battery-2nd Edition (SNSB-II)*. Human Brain Research & Consulting Co.
- Kim, H., & Na, D. L. (2012). *Paradise: Korean Version of the Western Aphasia Battery Revised (PK-WAB-R)*. Seoul, Paradise Welfare Foundation.
- Macwhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for studying discourse. *Aphasiology*, 25(11), 1286-1307.
- Nicholas, L. E., & Brookshire, R. H. (1993). A system for quantifying the informativeness and efficiency of the connected speech of adults with aphasia. *Journal of Speech, Language, and Hearing Research*, 36(2), 338-350.
- Olness, G. S., Ulatowska, H. K., Wertz, R. T., Thompson, J. L., & Auther, L. L. (2002). Discourse elicitation with pictorial stimuli in African Americans and Caucasians with and without aphasia. *Aphasiology*, 16(4-6), 623-633.

- Richardson, J. D., & Dalton, S. G. (2016). Main concepts for three different discourse tasks in a large non-clinical sample. *Aphasiology*, 30(1), 45-73.
- Richardson, J. D., & Dalton, S. G. H. (2020). Main concepts for two picture description tasks: an addition to Richardson and Dalton, 2016. *Aphasiology*, 34(1), 119-136.
- Stockbridge, M. D., Kelly, L., Newman-Norlund, S., White, B., Bourgeois, M., Rothermel, E., Fridriksson, J., Lyden, P. D., & Hillis, A. E. (2024). New picture stimuli for the NIH stroke scale: A validation study. *Stroke*, 55(2), 443-451.
- Steinberg, A., Lyden, P. D., & Davis, A. P. (2022). Bias in stroke evaluation: Rethinking the cookie theft picture. *Stroke*, 53(6), 2123-2125.
- Sohn, H.-M. (2001). *The Korean Language*. Cambridge University Press.
- Sung, J. E., DeDe, G., & Lee, S. E. (2016). Cross-Linguistic differences in a picture-description task between Korean- and English-speaking individuals with aphasia. *American Journal of Speech-Language Pathology*, 25(4), S813-s822.
- Sung, J. E., Scimeca, M., Li, R., & Kiran, S. (2024). Cross-linguistic and multicultural considerations in evaluating bilingual adults with aphasia. *American Journal of Speech-Language Pathology*, 33(6), 2716-2731.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Ministry of Science and ICT (MSIT) (No. 2022R1A2C2005062, RS-2024-00461617), by the National Research Council of Science & Technology (NST) grant funded by MSIT (No. CAP21054-000), by the NRF grant funded by the Ministry of Education (No. NRF-2022R111A4063209), and by the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare (No. HI23C0156).

Figure 1. Main concept analysis results for controls and persons with aphasia
(A) Analysis results using the original main concept (MC) criteria for controls (C); (B) Analysis results using the Korean-adjusted MC criteria for C; (C) Analysis results using the Korean-adjusted MC criteria for persons with aphasia (PWA).

* $p < .05$

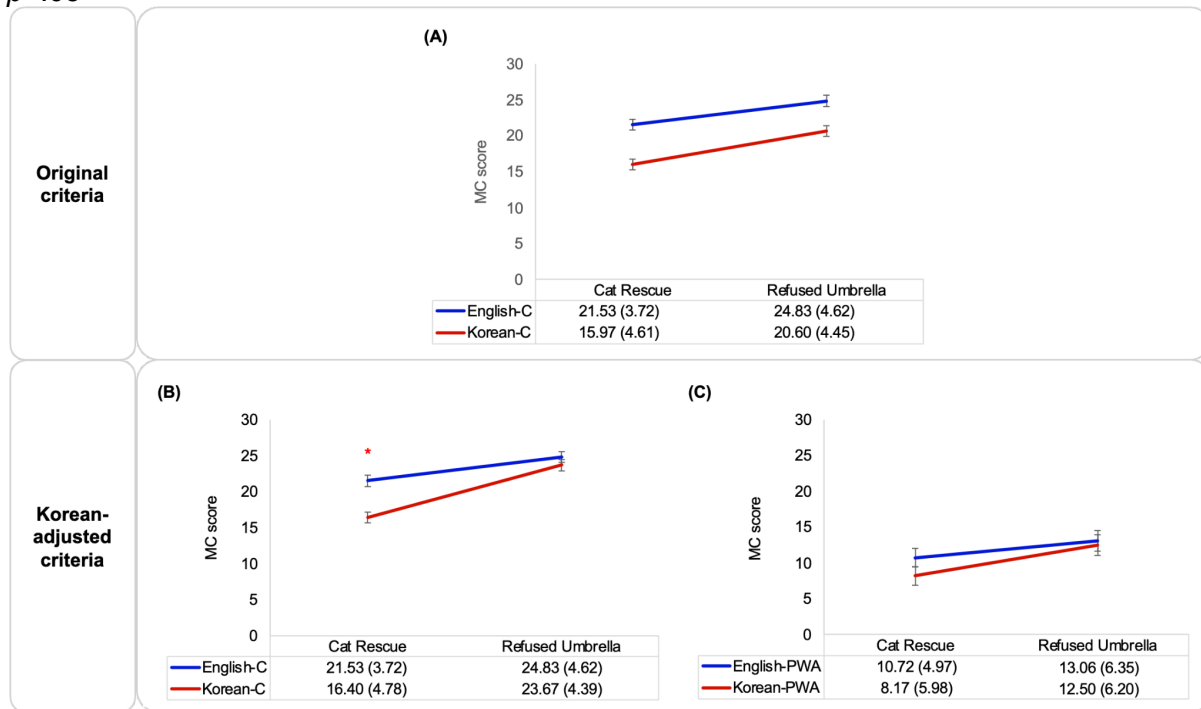


Table 1. Examples of original and Korean-adjusted MC criteria.

A Korean participant's utterance		Mom saw the weather forecast and said, "It's going to rain today, so take an umbrella", but <u>the kid</u> said "No". <u>So then went to school.</u>		
Essential elements		Main concept #4 ¹ <u>The boy</u> ² walks to ³ school .		
		Scoring system		
Original criteria	0	1	1	Rationale The subject (e.g., the boy, he) is omitted Subject omission is acceptable in Korean when the referent is mentioned in the preceding utterance. Since "the kid (the boy)" was previously produced, the response is scored as accurate.
Korean-adjusted criteria	1	1	1	

Acting vs. Cinderella Retelling: Individual Differences in Syntax Errors Between Primed and Discourse Tasks

Mia Parkes¹, Ashlynn Everett¹, Catherine Payne², Jeremy Yeaton², Catherine Off¹, Jenna Griffin¹, Simona Mancini³, and Danielle Fahey^{1,4*}

¹ School of Speech, Language, Hearing and Occupational Sciences, University of Montana, Missoula, MT, USA

² Language Sciences, University of California, Irvine, Irvine, CA, USA

³ Basque Center on Cognition Brain and Language, Donostia-San Sebastian, Spain

⁴ Department of Communication Disorders, University of Alabama, Tuscaloosa, AL, USA

***corresponding author, dkfahey@ua.edu**

Introduction

Post-stroke aphasia often results in grammatical deficits affecting both comprehension and production, including challenges with verbs, agreement, and complex syntax such as subordinate clauses and wh-movement (Butterworth & Howard, 1987; Centeno & Anderson, 2011; Centeno & Obler, 2001; Matchin et al., 2020; Thompson, 2019). This study examines the accuracy and use of subordinate clauses and pronouns in three monolingual participants with aphasia (PWA), comparing spontaneous production in naturalistic discourse (Task 1) with elicited use in a primed task (Task 2). By analyzing performance across tasks and modalities, we explore how task demands shape grammatical expression—either supporting access to structures or exposing breakdowns. These pilot findings lay the groundwork for future bilingual comparisons.

Methods (people, materials, procedure, analyses)

Participants were recruited from the Intensive, Comprehensive Aphasia Program (ICAP) at the University of Montana. Inclusion criteria included a clinical diagnosis of aphasia and native English proficiency; individuals were excluded for primary progressive aphasia, uncorrected hearing loss, dementia, head trauma, brain tumors, or severe cognitive impairments affecting consent or task participation. The final sample included individuals aged 52–60 with Western Aphasia Battery (WAB) scores ranging from 42 to 66.5 (Kertesz, 2006). Task-1 elicited naturalistic discourse through a retelling of Cinderella, transcribed in CLANc using standard CHAT conventions (MacWhinney, 2024), and analyzed for frequency and accuracy of pronoun and subordinate clause use. Task-2, a scripted, primed dialogue modeled on Rossi (2013), was designed to elicit imperatives, object clitics/pronouns, and subordinate clauses, with responses coded for binary accuracy. Pilot analyses focus on three participants (PWA-03, PWA-05, and PWA-08), comparing shared structures across both tasks to examine consistent patterns of preservation or loss.

Results

Participants' accuracy varied across tasks, with generally higher performance on pronouns and subordinate clauses in Task-1, likely reflecting avoidance of incorrect

structure use in Task-1. PWA-03 demonstrated high accuracy with pronouns (87.1%) and subordinate clauses (100%) in Task-1. However, a large discrepancy is observed in Task-2, where verb production dropped drastically (14.3%) despite perfect pronoun performance. PWA-05 did not attempt pronouns or subordinate clauses in Task-1. In Task-2, they produced pronouns accurately 64.06% of the time and subordinate clauses 17.19% of the time. PWA-08 used pronouns correctly 86.79% of the time and subordinate clauses 81.81% of the time in Task-1. However, Task-2 accuracy is substantially lower for both pronouns (34.43%) and verbs (26.23%).

Conclusions

Although priming is rarely used in aphasia research, its inclusion here reveals participants' access to grammatical structures not always produced spontaneously. Variability across tasks highlights how grammatical performance is shaped by task demands, emphasizing the need to assess language across multiple modalities. Future work will expand to include more monolingual and bilingual individuals with aphasia to explore treatment-relevant similarities and differences.

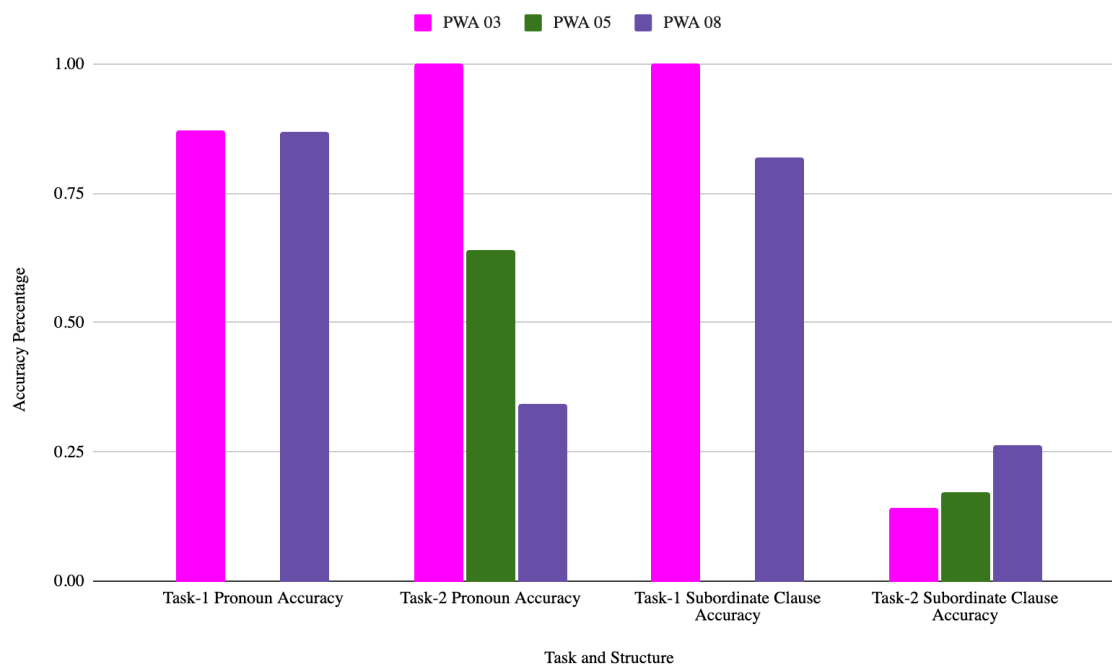
References

- Butterworth, B., & Howard, D. (1987). Paragrammatisms. *Cognition*, 26, 1–37.
- Centeno, J. G., & Anderson, R. T. (2011). A preliminary comparison of verb tense production in Spanish speakers with expressive restrictions. *Clinical Linguistics and Phonetics*, 25(10), 864–880.
- Centeno, J. G., & Obler, L. (2001). Agrammatic Verb Errors in Spanish Speakers and Their Normal Discourse Correlates How does access to this work benefit you ? Let us know ! Agrammatic verb errors in Spanish speakers and their normal discourse correlates I.
- Kertesz, A. (2006). Western Aphasia Battery-Revised (WAB-R). In APA PsycTests.
- MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk*. 3rd Edition. Lawrence Erlbaum Associates. <https://doi.org/10.21415/3mhn-0z89>
- Matchin, W., Basilakos, A., Stark, B. C., Den Ouden, D.-B., Fridriksson, J., & Hickok, G. (2020). Agrammatism and Paragrammatism: A Cortical Double Dissociation Revealed by Lesion-Symptom Mapping. *Neurobiology of Language*, 1–18. https://doi.org/10.1162/nol_a_00010
- Rossi, E. (2013). Modulating the sensitivity to syntactic factors in production: Evidence from syntactic priming in agrammatism. *Applied Psycholinguistics*, 36(3), 639–669. <https://doi.org/10.1017/S0142716413000374>
- Thompson, C. K. (2019). Neurocognitive Recovery of Sentence Processing in Aphasia. *Journal of Speech, Language, and Hearing Research*, 62(11), 3947.

Acknowledgments

This project was supported by a SEED grant and by start-up funds awarded to Danielle Fahey by the University of Montana.

Figure 1. Accuracy of pronoun and subordinate clause use across Task-1 and Task-2.



Syntactic Organization in Aphasia: Insights from Individual-Level Network Analyses of Connected Speech

Catherine T. Pham^{1*}, Peng Zhang¹, Nichol Castro², and Jiyeon Lee¹

¹ Department of Speech, Language, and Hearing Sciences, Purdue University, West Lafayette, IN, USA

² Department of Communicative Disorders and Sciences, University of Buffalo, Buffalo, NY, USA

*corresponding author, ctpham@purdue.edu

Introduction

Persons with aphasia (PWA) are often categorized as fluent or nonfluent based on clinicians' perceptual judgments. While these classifications guide diagnosis and treatment, fluency can be disrupted at various stages of production and does not reliably indicate underlying impairment. Network science offers a data-driven framework for quantifying language organization by modeling words as nodes and their relationships (e.g., semantic associations, grammatical dependencies) as edges (Albert & Barabási, 2002). Although this approach has been applied to various populations, work in aphasia has largely focused on *group-level semantic networks* from verbal fluency data. While prior work found structural differences between fluent and nonfluent PWA in lexical-semantic networks (Pham et al., 2025), group-level analyses obscures individual variability and are limited in their ability to guide treatment. Moreover, few studies have applied network analysis to connected speech, particularly to model syntactic structure. We examined *individual-level syntactic networks*, constructed from connected speech, to explore which network metrics relate to standardized language assessments and how fluency may moderate these relationships.

Methods

104 PWA completed the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2007) and Northwestern Assessment of Verbs and Sentences (NAVS; Thompson, 2012). Individual-level networks were constructed from connected speech elicited using the WAB-R picnic picture. For each PWA, we constructed two types of syntactic networks: dependency networks, where nodes represent words and edges reflect syntactic dependency relationships, and co-occurrence networks, where edges reflect linear adjacency between words. All networks were constructed using lemmatized forms. For each network, we computed various graph-theoretic metrics to quantify network structure and correlated these metrics with WAB AQ and NAVS subscores.

Results

Table 1 provides correlation matrices of network metrics and language test scores for both network types. In general, network metrics were more strongly correlated with production-based measures (i.e., ASPT, SPPT, VNT) than comprehension-based measures (i.e., SCT, VCT).

Linear regressions were used to examine the interaction between each network metric and WAB-R fluency subscore. A significant interaction between number of nodes and fluency on ASPT was observed for both network types (co-occurrence: $b = -4.77$, $t = -2.08$, $p = .04$; dependency: $b = -4.93$, $t = -2.15$, $p = .03$), indicating network size predicted sentence production more strongly for less fluent PWA. A similar pattern was observed between average degree (i.e., number of edges of nodes) and fluency on SPPT for co-occurrence networks, though this effect was marginal ($b = -6.47$, $t = -1.91$, $p = .06$).

Conclusions

Syntactic network structure was related to standardized language assessments in PWA, particularly production-based tasks. Notably, individual differences in fluency modulated the relationship between network metrics and syntactic production performance. Less fluent PWA showed stronger associations between network structure and syntax scores, suggesting they may depend more directly on the integrity of residual syntactic networks to support language planning and production. More fluent PWA may draw on compensatory strategies that are less dependent on syntactic organization. These findings point to the potential utility of syntactic networks as a clinically informative tool to understand how fluency impacts syntactic planning and guide individualized treatment.

References

- Albert, R., & Barabási, A.-L. (2002). Statistical mechanics of complex networks. *Reviews of Modern Physics*, 74(1), 47–97.
- Kertesz, A. (2007). *Western Aphasia Battery–Revised (WAB-R)*. The Psychological Corporation.
- Pham, C. T., Castro, N., & Lee, J. (2025). Semantic network analysis of verbal fluency advances understanding of aphasia word retrieval. [Poster Presentation]. Clinical Aphasiology Conference, Albuquerque, NM.
- Thompson, C. K. (2012). *Northwestern Assessment of Verbs and Sentences (NAVS)*. Northwestern University.

Acknowledgments

This work was supported by NIH R01DC019129.

Figure 1. Example of two different methods of network construction for different PWA

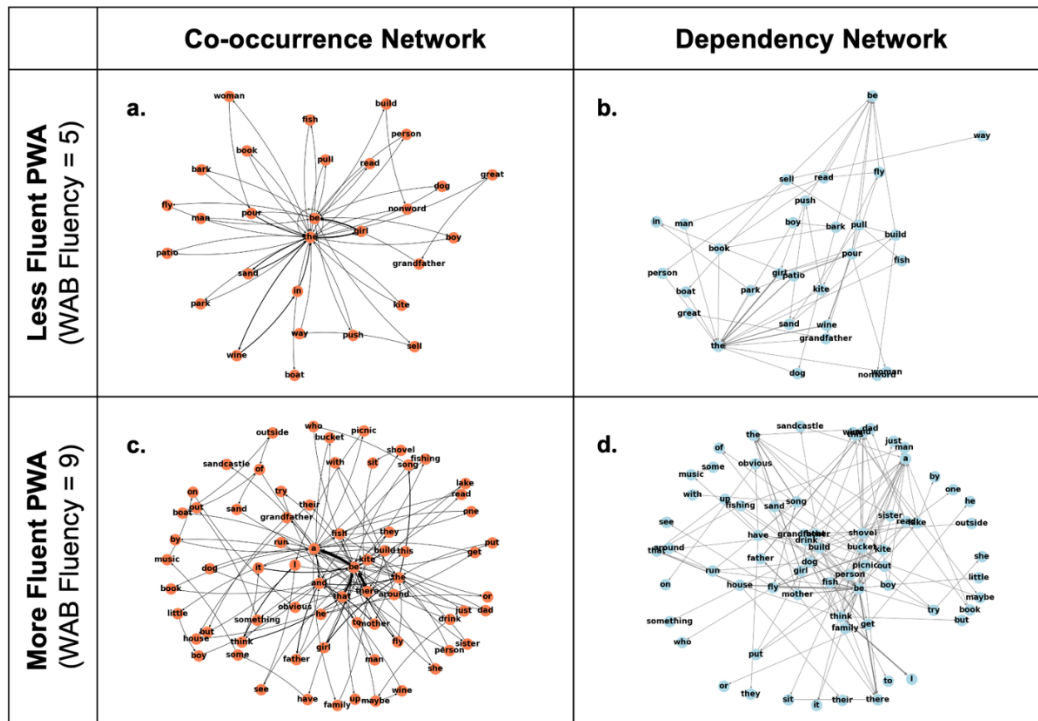


Table 1. Correlations of Language Measures and Network Metrics by Network Type

	CO-OCCURRENCE NETWORK						DEPENDENCY NETWORK					
	AQ	VNT	VCT	ASPT	SPPT	SCT	AQ	VNT	VCT	ASPT	SPPT	SCT
Hub Density	.51***	.45***	.27*	.52***	.42**	.29*	.5***	.41***		.49***	.39***	.29*
Average Degree Centrality	-.6***	-.55***	-.24*	-.52***	-.42**		-.56***	-.51***		-.47***	-.39***	
Diameter							.49***	.44***	.24*	.4***	.28**	.27*
Modularity							.35***	.35***		.26**	.29**	.21*
Global Efficiency	-.43***	-.38***		-.32**	-.32**	-.21*	-.5***	-.45***		-.37***	-.35***	-.2*
Clustering				.2*								-.29*
ASPL							.54***	.51***	.21*	.43***	.35***	.29*
Degree Entropy	.6***	.5***	.21*	.51***	.44**		.64***	.55***	.24*	.58***	.46***	
Average Degree	.34***	.26**		.32***			.41***	.3**		.38***	.25*	
Density	-.6***	-.55***	-.24*	-.52***	-.42**		-.57***	-.51***		-.47***	-.39***	
Edges	.43***	.35***		.4***	.29*		.45***	.35***		.41***	.31**	
Nodes	.51***	.43***		.46***	.37**		.52***	.43***		.47***	.38***	

Note. Pearson correlation coefficients (r) between network metrics (on the left) and standardized language assessment scores (across the top) for both co-occurrence and dependency networks. Each cell reflects the strength and direction of association between a given network metric and language measure. Higher absolute values indicate stronger correlations. Asterisks denote level of statistical significance: *** $p < .001$, ** $p < .01$, * $p < .05$. Empty cells indicate nonsignificant correlations. AQ = aphasia quotient; VNT = verb naming test, VCT = verb comprehension test; ASPT = argument structure production test; SPPT = sentence production priming test SCT = sentence comprehension test.

Singing supports motor speech and syntax production: evidence from aphasia

Alexis L. Pracar^{1*}, Maria V. Ivanova¹, Nicoletta Biondo², and Nina F. Dronkers¹

¹ Department of Psychology, University of California, Berkeley, CA, USA

² Department of Neurology, University of California, San Francisco, CA, USA

*corresponding author, pracar@berkeley.edu

Introduction

Singing has long been observed to facilitate language production in individuals with aphasia, yet the mechanisms underlying this effect remain poorly understood. One possibility is that singing recruits alternative motor or linguistic pathways that can compensate for deficits caused by stroke. However, the benefit of singing may depend on the type of linguistic impairment. Apraxia of speech (AOS), a disorder affecting motor planning for speech, may be particularly responsive to rhythmically and melodically structured output (Duffy, 2019; Zumbansen et al., 2014). Similarly, syntactic deficits may engage hierarchical planning processes, like working memory, that overlap with those required for musical expression (Cecchetti et al., 2021). In contrast, lexical retrieval relies more on semantic and naming networks, which may not directly benefit from the structure provided by song. Here, we investigate the impact of singing versus speaking across three language tasks targeting different levels of linguistic processing in individuals with aphasia, stratified by the presence or absence of relevant deficits.

Methods

We analyzed performance from three tasks—motor speech production, syntax production, and word retrieval—in a sample of individuals with chronic post-stroke aphasia (N=20). Each participant completed both “sing” and “speak” conditions. Using linear mixed-effects models, we tested for the main effects of Condition (speak, sing), presence of deficit (AOS, fluency, or naming, depending on the task, all derived from the Western Aphasia Battery (Kertesz, 2007)), and their interaction, with Participant included as a random intercept. Estimated marginal means and pairwise contrasts were computed to assess whether singing significantly altered performance within each deficit group. Effect sizes were calculated using Cohen’s *d* based on model estimates.

Results

In the motor speech sentence production task (Fig. 1), participants with AOS showed significantly better performance in the singing condition compared to speaking (mean improvement = 13.3%, $p = 0.0033$; Cohen’s $d = -1.68$), while those without AOS showed no difference. Similarly, in the syntax task, singing improved performance for individuals with fluency deficits (mean improvement = 7.2%, $p = 0.003$; $d = 1.56$), but not for those with preserved fluency. In contrast, no significant difference between singing and speaking was observed in the word retrieval task, regardless of naming deficit status (all $p > 0.5$; $d < 0.2$).

Conclusions

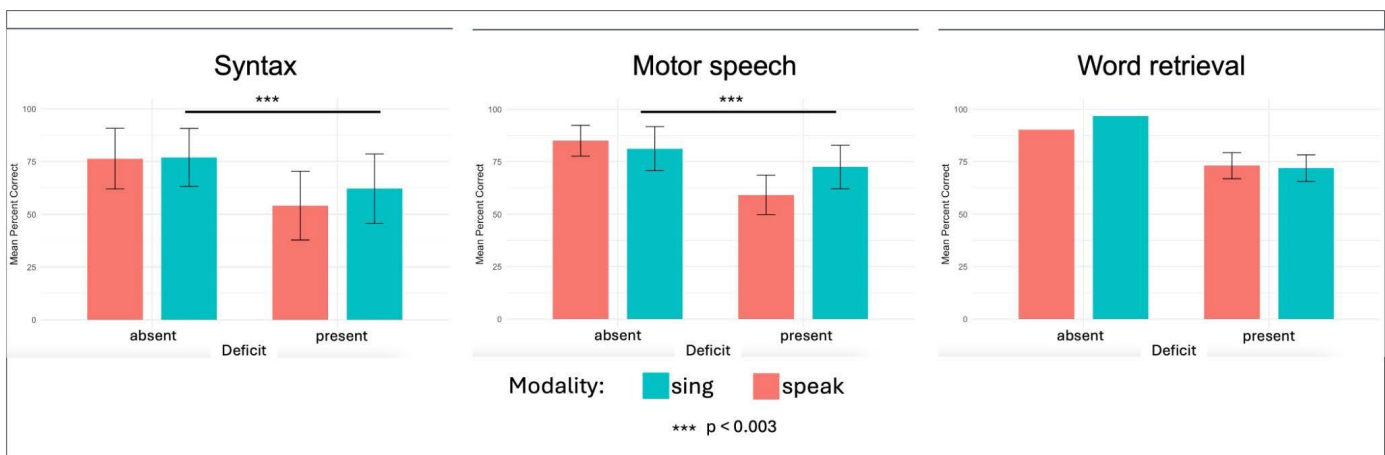
These findings suggest that singing preferentially supports word- and sentence-level

production in individuals with motor speech or syntactic impairments. No measurable benefit was found for lexical access. The structure and prosody of singing may provide external scaffolding that supports planning and sequencing of articulatory or syntactic components, particularly when the motor or fluency system is compromised. However, singing does not appear to facilitate retrieval of individual lexical items. These results could inform rehabilitation strategies by identifying subgroups of aphasia patients—particularly those with AOS or fluency deficits—who may benefit most from singing-based interventions.

References

- Cecchetti, G., Herff, S. A., & Rohrmeier, M. A. (2021). Musical syntactic structure improves memory for melody: Evidence from the processing of ambiguous melodies. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 43, No. 43).
- Duffy, JR. *Motor speech disorders e-book: substrates, differential diagnosis, and management*. Philadelphia: Elsevier Health Sciences (2019).
- Kertesz, A. (2007). Western Aphasia Battery--Revised.
- Zumbansen, A., Peretz, I., & Hébert, S. (2014). Melodic intonation therapy: back to basics for future research. *Frontiers in Neurology*, 5, 7.

Figure 1. Mean percent correct for task, grouped by presence or absence of specific speech or linguistic deficit. Significant difference between groups marked with asterisks. For the motor speech and syntax tasks, having a deficit in those specific functions resulted in a benefit for singing compared to speaking.



Altered Temporal Dynamics during Syntactic Integration in Nonfluent Variant Primary Progressive Aphasia

M. Blake Rafferty¹, Heather R. Dial^{2,3}, Rachel S. Tessmer^{3,4}, and Maya L. Henry^{3,5}

¹ Department of Communication Disorders, New Mexico State University, Las Cruces, NM, USA

² Department of Communication Sciences and Disorders, University of Houston, Houston, TX, USA

³ Department of Speech, Language and Hearing Sciences, The University of Texas at Austin, Austin, TX, USA

⁴ Geriatric Research, Education, and Clinical Center, VA Pittsburgh Healthcare System, Pittsburgh, PA, USA

⁵ Department of Neurology, The University of Texas at Austin, Austin, TX, USA

***corresponding author, hrdial@central.uh.edu**

Introduction

Nonfluent variant primary progressive aphasia (nfvPPA) is a neurodegenerative disorder characterized by morphosyntactic deficits (Gorno-Tempini et al., 2011; Thompson & Mack, 2014) due to progressive left fronto-insular atrophy (Charles et al., 2014; Lorca-Puls et al., 2024). Individuals with nfvPPA struggle with complex syntax comprehension, particularly for non-canonical word orders (Thompson & Mack, 2014). Evidence suggests that the processing burden associated with non-canonical sentences is attributable, at least in part, to costs incurred on domain-specific morphosyntactic working memory (WM) localized to the left inferior frontal gyrus (Makuuchi et al., 2009; Matchin & Hickok, 2020; Xiao et al., 2016). Such costs have been computationally formalized within Dependency Locality Theory (DLT) as consisting of two components: a) storage, reflecting burden imposed by maintaining incomplete syntactic dependencies in WM, and b) integration, reflecting effort required to form syntactic dependencies over intervening linguistic content (Gibson, 1998; Shain et al., 2016). The neurodegeneration profile and comprehension deficits seen in nfvPPA align with evidence informing WM-based explanations of non-canonical sentence processing. In part, nfvPPA may be characterized by a progressive morphosyntactic WM deficit, evidenced by altered processing dynamics for high storage and/or integration costs.

Methods

To test this hypothesis, we constructed an encoding model (temporal response function, TRF) to quantify the temporal alignment between electroencephalography (EEG) data and word-by-word indices of morphosyntactic WM storage and integration cost, derived according to DLT rules (Shain et al., 2016; Shain et al., 2022). EEG data were collected from individuals with nfvPPA (n = 10) and neurologically healthy controls (n = 10) as they listened to 15 minutes of an audiobook. To identify the unique contributions of morphosyntactic WM storage and integration costs, we controlled for acoustic and lexical features. We examined the resulting prediction accuracy, reflecting the strength of fit between observed and TRF-predicted EEG, and TRF, which characterizes temporal

changes in the relationship between the EEG and acoustic/linguistic features. Integration, but not storage, costs improved prediction accuracy relative to control predictors. We thus evaluated group-level differences in the TRFs using peak analyses and mixed effects models on peak features (latency, peak-to-peak latency) for the unique contribution of integration costs.

Results

We identified four TRF peaks—timepoints where neural alignment with integration costs was high. We observed a significant group-by-peak interaction on peak latency. The nvPPA group showed slower responses for peaks 1 and 2, but faster latencies at peaks 3 and 4.

Conclusions

Individuals with nvPPA showed delayed responses to early integration demands during temporal windows associated with automatic syntactic encoding (Peaks 1 & 2; Coopmans et al., 2025; Flick & Pylkkänen, 2020), but faster latencies in later windows associated with prosodic-syntactic integration (Peak 3; Steinhauser & Friederici, 2001) and syntactic reanalysis and argument structure interpretation (Peak 4; Bornkessel-Schlesewsky & Schlewsky, 2008; Regel et al., 2014; Tanner et al., 2017). These altered dynamics may index a processing cascade wherein early encoding is slow and unstable. In response to instability, individuals with nvPPA may try to salvage comprehension by engaging in early prosodic-syntactic integration, reanalysis, or thematic assignment. However, this may not be successful, leading to miscomprehension. Ongoing work is examining the relation between TRF-derived syntactic processing measures and traditional behavioral measures to more precisely identify the impact of early encoding deficits on syntactic comprehension.

References

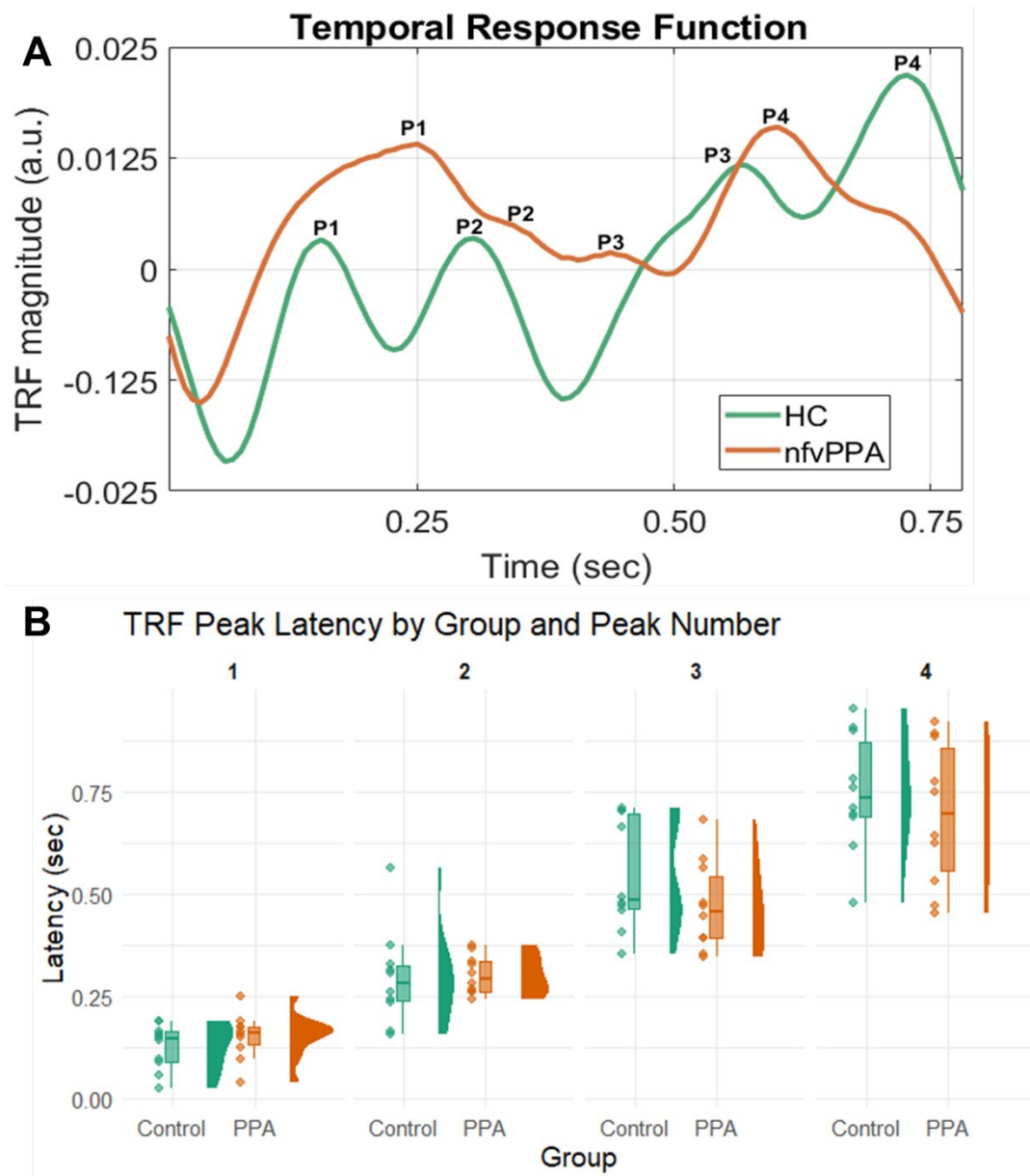
- Bornkessel-Schlesewsky, I., & Schlewsky, M. (2008). An alternative perspective on “semantic P600” effects in language comprehension. *Brain research reviews*, 59(1), 55-73.
- Charles, D., Olm, C., Powers, J., Ash, S., Irwin, D. J., McMillan, C. T., ... & Grossman, M. (2014). Grammatical comprehension deficits in non-fluent/agrammatic primary progressive aphasia. *Journal of Neurology, Neurosurgery & Psychiatry*, 85(3), 249-256.
- Coopmans, C. W., De Hoop, H., Tezcan, F., Hagoort, P., & Martin, A. E. (2025). Language-specific neural dynamics extend syntax into the time domain. *PLoS biology*, 23(1), e3002968.
- Flick, G., & Pylkkänen, L. (2020). Isolating syntax in natural language: MEG evidence for an early contribution of left posterior temporal cortex. *Cortex*, 127, 42-57.
- Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, 68(1), 1-76.
- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S. F., ... & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.

- Lorca-Puls, D. L., Gajardo-Vidal, A., Mandelli, M. L., Illán-Gala, I., Ezzes, Z., Wauters, L. D., ... & Gorno-Tempini, M. L. (2024). Neural basis of speech and grammar symptoms in non-fluent variant primary progressive aphasia spectrum. *Brain*, 147(2), 607-626.
- Makuuchi, M., Bahlmann, J., Anwender, A., & Friederici, A. D. (2009). Segregating the core computational faculty of human language from working memory. *Proceedings of the National Academy of Sciences*, 106(20), 8362-8367.
- Matchin, W., & Hickok, G. (2020). The cortical organization of syntax. *Cerebral Cortex*, 30(3), 1481-1498.
- Regel, S., Meyer, L., & Gunter, T. C. (2014). Distinguishing neurocognitive processes reflected by P600 effects: Evidence from ERPs and neural oscillations. *PloS one*, 9(5), e96840.
- Shain, C., Van Schijndel, M., Futrell, R., Gibson, E., & Schuler, W. (2016, December). Memory access during incremental sentence processing causes reading time latency. In *Proceedings of the workshop on computational linguistics for linguistic complexity (CL4LC)* (pp. 49-58).
- Shain, C., Blank, I. A., Fedorenko, E., Gibson, E., & Schuler, W. (2022). Robust effects of working memory demand during naturalistic language comprehension in language-selective cortex. *Journal of Neuroscience*, 42(39), 7412-7430.
- Steinhauer, K., & Friederici, A. D. (2001). Prosodic boundaries, comma rules, and brain responses: The closure positive shift in ERPs as a universal marker for prosodic phrasing in listeners and readers. *Journal of psycholinguistic research*, 30, 267-295.
- Tanner, D., Grey, S., & van Hell, J. G. (2017). Dissociating retrieval interference and reanalysis in the P600 during sentence comprehension. *Psychophysiology*, 54(2), 248-259.
- Thompson, C. K., & Mack, J. E. (2014). Grammatical impairments in PPA. *Aphasiology*, 28(8-9), 1018-1037.
- Xiao, Y., Friederici, A. D., Margulies, D. S., & Brauer, J. (2016). Development of a selective left-hemispheric fronto-temporal network for processing syntactic complexity in language comprehension. *Neuropsychologia*, 83, 274-282.

Acknowledgments

This work was supported by grants from the National Institute of Health National Institute on Deafness and Other Communication Disorders (F32DC016812, awarded to Heather Dial and R01DC016291 awarded to Maya Henry).

Figure 1. A. Group-averaged TRFs for integration costs. Average peak latencies for each peak are labeled for each group. Peaks were identified on a per-participant basis using the *findpeaks* function in MATLAB with the minimum peak width set at four samples (40ms) at half-maximum. B. TRF peak latencies for each group and peak. Note that intersubject variability in peak latency and magnitude resulted in temporal overlap between subjects for distinct peaks. Thus, in the group-averaged TRF (panel A), peaks appear less prominent or temporally shifted compared to the individual participant peaks.



Caregiver and Patient with aphasia Communication Dynamics: A Pilot Study on Barriers and Strategies

Ayana Das Ramdasan^{1*}, Akshay P Vibin², and Krishnedu K R¹

¹Speech language Therapist, Dubai center for special needs, Dubai.

Speech language pathologist, specialist rehabilitation center Mysore.

² Speech Language Therapist, HIMMA Physical Medicine and Rehabilitation Center, Midriff, Dubai

***Corresponding author, ayanadas1996@gmail.com**

Introduction

Aphasia is a language disorder caused by damage to the brain's language centers, often due to stroke or injury, resulting in impairments in comprehension, expression, reading, and writing. The linguistic impairments associated with aphasia can lead to communication breakdowns, which in turn hinder effective interactions between caregivers and patients. This pilot study aims to explore communication barriers faced by persons with aphasia (PWA) and their caregivers, focusing on linguistic and environmental factors such as comprehension, expression, emotional understanding, and distractions. It seeks to identify common breakdowns, preferred strategies, and contextual influences to inform culturally appropriate clinical interventions.

Methods

A cross-sectional survey design was used to explore communication challenges and strategies among persons with aphasia (PWAs) and their caregivers. Two structured questionnaires were developed one for PWAs (18 yrs. to 80 yrs.) and caregivers majorly who were spouses of PWA addressing key areas such as communication preferences, emotional expression, turn-taking, language mixing, and conversational skills. The self-report questionnaire was developed as it provides carers more freedom in their answers and promotes deeper thought. After determining its validity, the questionnaire was administered on the caregivers and PWA. The study included 16 PWAs and 16 caregivers, selected through convenience sampling. Questionnaires were administered either in person or via digital platforms, depending on participant accessibility and comfort. Responses were collected anonymously and analyzed using descriptive statistics, with frequencies and percentages calculated for key items. Ethical approval was obtained prior to data collection, and informed consent was taken from all.

Results

The study, based on responses from 16 PWAs and 16 caregivers, found that 63% of PWAs and 69% of caregivers preferred allowing PWAs to express their needs. Turn-taking was valued by 75% of PWAs and 88% of caregivers. Emotional expression was difficult for 50% of PWAs, and 44% of caregivers struggled to interpret emotions. Language mixing and conversational difficulties were common. Caregivers often used simplified language but less often gestures or written aids. Both groups emphasized the

need for patience and structured communication, highlighting the importance of consistent support and increased caregiver awareness.

Conclusions

This pilot study highlights the value of structured questionnaires in identifying real-world communication barriers in aphasia. Results emphasize the need for caregiver training, adaptive strategies, and environmental adjustments. These insights will shape a comprehensive tool to guide therapy planning and inform a larger-scale study, bridging research and clinical practice.

References

- Benson, D. F., & Ardila, A. (1996). *Aphasia: A clinical perspective*. Oxford University Press.
- Dorze, G., & Signiri, H. (2010). Needs, barriers and facilitators experienced by spouses of people with aphasia. *Disability and Rehabilitation*, volume (32), Page Number (1073–1087).
- Hersh, D., Worrall, L., Howe, T., Sherratt, S., & Davidson, B. (2012). SMARTER goals for adults with aphasia: A review of goal-setting practices in speech-language pathology. *International Journal of Speech-Language Pathology*, 14(6), 512–519. <https://doi.org/10.3109/17549507.2012.700323>
- Johnson, J., & Worrall, L. (2010). The communicative environment of older people with aphasia: Influences on communicative success and implications for intervention. *Aphasiology*, 24(9), 1090–1120. <https://doi.org/10.1080/02687030903058613>
- Kagan, A., Black, S. E., Duchan, J. F., Simmons-Mackie, N., & Square, P. (2001). Training volunteers as conversation partners using “Supported Conversation for Adults with Aphasia” (SCA): A controlled trial. *Journal of Speech, Language, and Hearing Research*, 44(3), 624–638. [https://doi.org/10.1044/1092-4388\(2001/051\)](https://doi.org/10.1044/1092-4388(2001/051)).
- McGurk., & Kneebone, I. (2011). Sometimes we get it wrong but we keep on trying: Across sectional study of coping with communication problem by informal carers of stroke survivors with aphasia. *Aphasiology*. Volume (25), Page Number (1507-1522).
- Small, J., & Kathy, G. (2000). *American journal of Alzheimer’s disease and other dementias*, Volume (15).
- Simmons-Mackie, N., Raymer, A., Armstrong, E., Holland, A., & Cherney, L. R. (2010). Communication partner training in aphasia: A systematic review. *Archives of Physical Medicine and Rehabilitation*, 91(12), 1814–1837. <https://doi.org/10.1016/j.apmr.2010.08.026>

Cortical Hierarchy and Aphasia Severity: The Sensorimotor–Association Gradient Modulates Lesion Effects Within Language-Specific Networks

Ida Rangus^{1,2*}, Nicholas Riccardi¹, Julius Fridriksson¹, and Leonardo Bonilha³

¹ Department of Communication Sciences and Disorders, University of South Carolina, Columbia, SC, USA

² Center for Stroke Research Berlin, Charité – Universitätsmedizin Berlin, Berlin, Germany

³ School of Medicine Columbia, University of South Carolina, Columbia, SC, USA

***corresponding author, irangus@mailbox.sc.edu**

Introduction

Aphasia severity varies substantially among stroke survivors. Although lesion size and location are established predictors of language outcomes, they do not fully account for this variability, limiting our mechanistic understanding of how brain damage translates into aphasia (Price et al., 2010; Thye & Mirman, 2018). Language-specific (LS) and domain-general (DG) regions are embedded within a broader cortical organizational principle – the sensorimotor to association (S-A) axis – which reflects a functional hierarchy from primary sensory/motor to higher-order association cortices (Sydnor et al., 2021). Despite its neurobiological relevance, this hierarchical gradient has not yet been factored into aphasia prediction models. We hypothesized that comparable LS or DG lesion loads associated with higher sensorimotor representation, would result in more severe aphasia, given the more specialized nature, lower capacity for functional reorganization, and limited redundancy inherent to primary sensorimotor regions compared to association cortices.

Methods

We analyzed data from 236 individuals with chronic left-hemisphere stroke drawn from the Aphasia Recovery Cohort (Gibson et al., 2024). Aphasia severity was assessed using the Western Aphasia Battery-Revised Aphasia Quotient (WAB-R-AQ) (Kertesz, 2007). Lesions were parcellated using an established cortical atlas to extract region-wise lesion volumes, which were then weighted according to each region's S-A ranking. Individual lesion volumes and proportional S-A ranks were calculated for LS and DG regions of interest (ROIs) (Figure 1). Hierarchical linear regression models were used to evaluate whether incorporating S-A ranking and its interaction with lesion volume improved prediction of aphasia severity, beyond lesion volume and location within LS or DG regions. Covariates included total lesion volume, age, sex, and time post-stroke. Separate models were constructed for LS, DG and combined LS+DG ROIs.

Results

Across all models, total lesion volume consistently emerged as a strong negative predictor of aphasia severity. Importantly, adding the interaction between lesion volume and S-A ranking significantly improved model fit. Lesions located in lower S-A regions (closer to primary sensorimotor areas) were associated with greater language impairment than lesions in higher-order association areas. Among all models tested, those restricted

to LS regions demonstrated the highest explanatory power (Table 1). Model fit improved progressively with each step: the adjusted R^2 increased from 0.378 in the baseline model to 0.395 when S-A ranking was added, and further to 0.426 in the full interaction model. These findings indicate that accounting for cortical hierarchy, specifically the interaction between lesion volume and S-A ranking within LS regions, substantially enhances the prediction of aphasia severity beyond lesion volume or location alone.

Conclusions

Our results reveal that the position of affected cortical regions along the sensorimotor-to-association gradient meaningfully influences aphasia severity, beyond traditional lesion metrics. In particular, lower-order LS regions appear to be disproportionately impactful when damaged. To our knowledge, this is the first study to incorporate the S-A axis into lesion-symptom mapping for aphasia. This biologically grounded framework offers new insights into the neural basis of language impairment and provides a novel dimension for improving post-stroke outcome prediction models. Future work should explore the relevance of cortical hierarchy in recovery trajectories and treatment response.

References

- Faria, A. V., Joel, S. E., Zhang, Y., Oishi, K., Van Zijl, P. C. M., Miller, M. I., Pekar, J. J., & Mori, S. (2012). Atlas-based analysis of resting-state functional connectivity: Evaluation for reproducibility and multi-modal anatomy–function correlation studies. *NeuroImage*, 61(3), 613–621. <https://doi.org/10.1016/j.neuroimage.2012.03.078>
- Gibson, M., Newman-Norlund, R., Bonilha, L., Fridriksson, J., Hickok, G., Hillis, A. E., Den Ouden, D.-B., & Rorden, C. (2024). The Aphasia Recovery Cohort, an open-source chronic stroke repository. *Scientific Data*, 11(1), 981. <https://doi.org/10.1038/s41597-024-03819-7>
- Kertesz, A. (2007). *WAB-R: Western Aphasia Battery-Revised*. The Psychological Corporation.
- Price, C. J., Seghier, M. L., & Leff, A. P. (2010). Predicting language outcome and recovery after stroke: The PLORES system. *Nature Reviews Neurology*, 6(4), 202–210. <https://doi.org/10.1038/nrneurol.2010.15>
- Sydnor, V. J., Larsen, B., Bassett, D. S., Alexander-Bloch, A., Fair, D. A., Liston, C., Mackey, A. P., Milham, M. P., Pines, A., Roalf, D. R., Seidlitz, J., Xu, T., Raznahan, A., & Satterthwaite, T. D. (2021). Neurodevelopment of the association cortices: Patterns, mechanisms, and implications for psychopathology. *Neuron*, 109(18), 2820–2846. <https://doi.org/10.1016/j.neuron.2021.06.016>
- Thye, M., & Mirman, D. (2018). Relative contributions of lesion location and lesion size to predictions of varied language deficits in post-stroke aphasia. *NeuroImage: Clinical*, 20, 1129–1138. <https://doi.org/10.1016/j.nicl.2018.10.017>

Acknowledgments

This work was supported by National Institute on Deafness and Other Communication Disorders Grant P50 DC014664 (PI: Julius Fridriksson).

Figure 1. Visualization of the Sensorimotor-Association (S-A) Axis. The S-A axis is shown mapped onto axial brain slices (A) and 3D brain surface renderings (B: lateral view, C: medial view), using the JHU atlas parcellation (Faria et al., 2012). In (B) and (C) language-specific ROIs are outlined in black and domain-general ROIs are outlined in gray. Warmer colors indicate higher S-A ranks (associative cortices) and cooler colors correspond to lower S-A ranks (sensorimotor cortices). In panel A, stroke lesion overlap is also displayed, with color intensity representing the number of participants with a lesion at each voxel – lighter (yellow) shades denote higher overlap. (D) Cumulative lesion volumes across different regions.

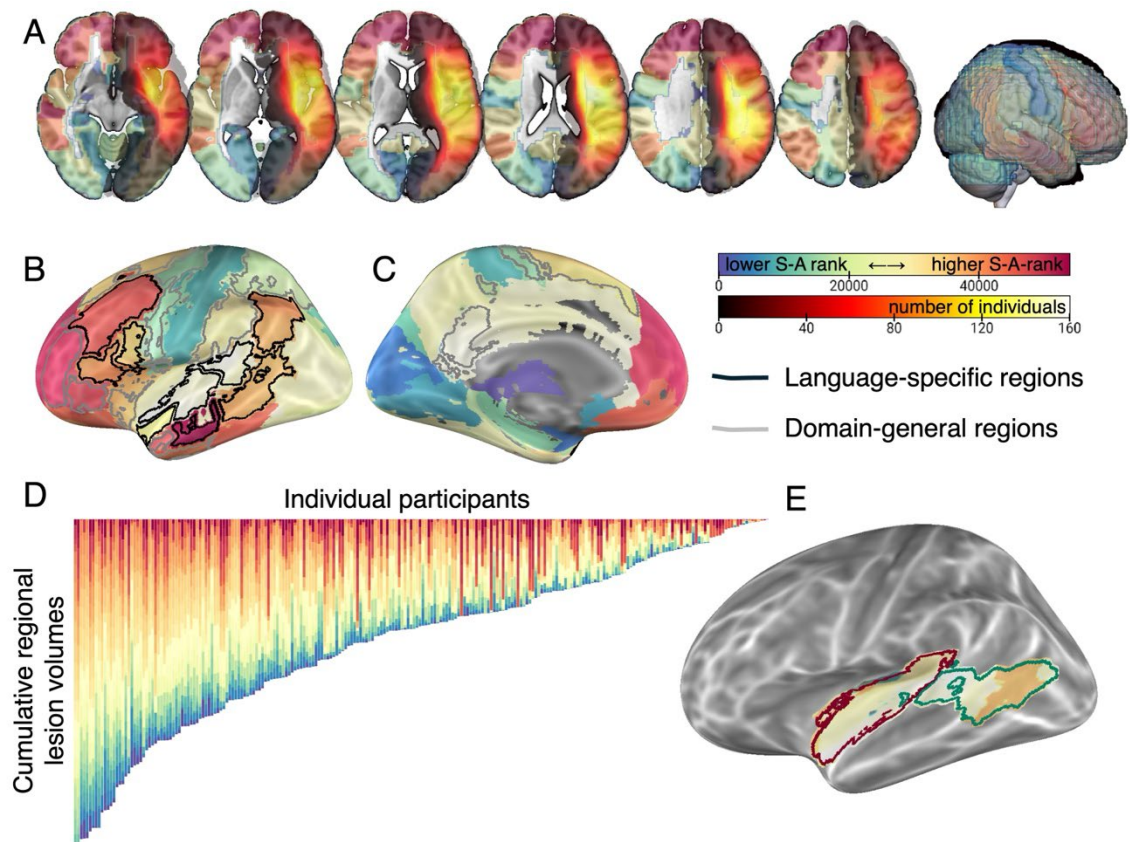


Table 1: Hierarchical Regression Analysis (Language-specific ROIs)

	Estimate (B)	Std. β	Std. Error	t-value	p-value
Model 1 (Baseline Model): dependent variable: WAB-R-AQ:					
Adjusted R² = 0.378, residual St. Error: 21.32 (df = 220), F(5,220) = 28.38, p < 2.2 × 10⁻¹⁶					
Intercept)	88.877	-	9.981	8.905	<2.2 × 10 ⁻¹⁶ ***
Lesion vol. in LS ROIs	-0.178	-0.219	0.110	-1.618	0.107
Total lesion vol.	-0.121	-0.431	0.038	-3.177	0.002 **
Age	-0.210	-0.085	0.134	-1.569	0.118
Sex	2.810	0.050	2.982	0.942	0.347
Months post-stroke	0.059	0.115	0.028	2.132	0.034 *
Model 2 (S-A Extended Model): dependent variable: WAB-R-AQ:					
Adjusted R² = 0.395, residual St. Error: 21.03 (df = 219), F(6,219) = 25.53, p < 2.2 × 10⁻¹⁶					
(Intercept)	91.349	-	9.885	9.241	< 2 × 10 ⁻¹⁶ ***
Lesion vol. in LS ROIs	-1.678	-2.059	0.568	-2.957	0.003 **
Total lesion vol.	-0.169	-0.600	0.042	-4.060	6.83 × 10 ⁻⁰⁵ ***
S-A ranking	0.001	2.001	0.001	2.693	0.008 **
Age	-0.225	-0.091	0.132	-1.705	0.090 .
Sex	2.763	0.049	2.941	0.940	0.348
Months post-stroke	0.056	0.110	0.027	2.055	0.041 *
Model 3 (Interaction Model): dependent variable: WAB-R-AQ:					
Adjusted R² = 0.426, residual St. Error: 20.48 (df = 218), F(7,218) = 24.89, p < 2.2 × 10⁻¹⁶					
(Intercept)	92.050	-	9.631	9.558	< 2 × 10 ⁻¹⁶ ***
Lesion vol. in LS ROIs	-1.466	-1.800	0.556	-2.637	0.009 **
Total lesion vol.	-0.203	-0.722	0.042	-4.878	2.07 × 10 ⁻⁰⁶ ***
S-A ranking	2.407 × 10 ⁻⁰⁴	1.305	1.383 × 10 ⁻⁰⁴	1.741	0.083 .
Age	-0.137	-0.055	0.131	-1.045	0.297
Sex	3.155	0.057	2.867	1.101	0.272
Months post-stroke	0.060	0.118	0.027	2.265	0.025 *
Lesion size in LS ROIs × S-A ranking	9.565 × 10 ⁻⁰⁷	0.589	2.672 × 10 ⁻⁰⁷	3.579	0.0004 ***

Significance codes: ***: p < 0.001, **: p < 0.01, *: p < 0.05, .: p < 0.1

Abbreviations: LS = language-specific, vol. = volume, ROIs = regions of interest, S-A = sensorimotor-association (axis), WAB-R-AQ = Western Aphasia Battery-Revised Aphasia Quotient.

Word-Form Learning and Re-learning in the Aging Brain

Brenda Rapp¹, Yuan Tao¹, Sartaj Singh², Jennifer Shea¹, and Robert Wiley²

¹Johns Hopkins University

²University of North Carolina Greensboro

*corresponding author, brapp1@jhu.edu

Introduction

Age-related decline has been documented in many cognitive areas, including in word processing (e.g., lexical retrieval). This occurs although older adults reliably outperform younger adults in vocabulary knowledge. What is not well-understood is if, and to what extent, aging affects word learning and relearning (e.g., subsequent to stroke). We report on two studies, one examining word-form learning in older adults and another investigating response to behavioral treatment in post-stroke dysgraphia. The findings have implications for understanding the effect of aging on the neural mechanisms underlying word learning which may, in turn, contribute to treatment outcomes in post-stroke aphasia.

Methods

Study 1: Treatment in post-stroke dysgraphia

Participants were 20 individuals (mean age = 63 years, mean time post-stroke = 81 months). Data examined were from dysgraphia treatment involving multiple training repetitions of each word (mean = 18 sessions, over mean = 10 weeks). Shea et al. (2022) reported significant improvement for trained and untrained words (p 's < .001). Here we evaluated the effect of age on the extent of "re-learning".

Study 2: Word learning in older adults

Participants were healthy younger adults (YA; $N=18$; ages 18-35) and older adults (OA; $N=23$; ages 55-80). Modelled after Tao et al. (2024), participants were tasked with learning the correct spelling of 10 novel pseudowords while undergoing fMRI scanning, with 8 learning trials for each target.

Analysis and Results

Study 1

We used LME modelling to predict behavioral scores from the following regressors: Training Repetition, Age, Training Repetition x Age, WAB-AQ, Total Lesion Volume, and Pre-Treatment Accuracy. We found that older adults were significantly less accurate on average across training ($p < .001$) and tended to improve less with each additional Repetition ($p \approx .079$), altogether indicating that older adults re-learned less accurately.

Study 2

Behavior: Regarding word learning during scanning, OA were significantly less accurate, $M = 0.60$, than YA, $M = 0.74$ ($t(39) = 2.65$, $p \approx .01$).

Neural response: Trials were binned into "memory strengths" (MS; weak, medium, strong) as in Law et al. (2005). BOLD response was extracted, per participant, for each MS level bilaterally in the hippocampus and VWFA. Bayesian multilevel models regressed BOLD

on MS, Group (OA vs YA), and their interaction, separately for the hippocampus and VWFA.

Hippocampus: Across MS levels, YAs showed a significant *rising* BOLD response bilaterally (p 's < .02); OAs showed similar but non-significant effects bilaterally. VWFA: YAs showed a significant *falling* pattern across MS levels bilaterally (p 's < .01); OAs showed non-significant effects in both hemispheres.

Conclusions

We found that older adults, who struggle to learn novel orthographic word forms, did not show the learning-related neural responses subcortically (hippocampus) or cortically (VWFA) typically seen in younger adults during learning. This raises the possibility that similar neural changes may underlie the effects of aging on responsiveness to treatment that we (and others) have documented. It will be important to directly examine this possibility in future investigations.

References

- Law, J.R., Flanery, M.A., Wirth, S., Yanike, M., Smith, A.C., Frank, L.M., Suzuki, W.A., Brown, E.N., & Stark, C.E.L. Functional magnetic resonance imaging activity during the gradual acquisition and expression of paired-associate memory. *The Journal of Neuroscience*, 25(24):5720-5729.
- Shea, J., Wiley, R., Moss, N., & Rapp, B. (2022). Pseudoword spelling ability predicts response to word spelling treatment in acquired dysgraphia. *Neuropsychological Rehabilitation*, 32(2): 231-267.
- Tao, Y., Schubert, T., Wiley, R., Stakr, C., & Rapp, B. (2024). Cortical and subcortical mechanisms of orthographic word-form learning. *Journal of Cognitive Neuroscience*, 36(6): 1071-1098.

Bilingual Aphasia and Aging

Stephanie K. Ries^{1*}, Stephanie M. Grasso², Miguel Ángel Santos Santos³, Eve Higby⁴, Tamar H. Gollan⁵, Matthew Goldrick⁶, and Mira Goral⁷

1. School of Speech, Language, and Hearing Sciences and Center for Clinical and Cognitive Neuroscience, San Diego State University, San Diego, CA, USA
2. Department of Speech, Language and Hearing Sciences, University of Texas at Austin, Austin, TX, USA.
3. Unidad de Memoria, Departamento de Neurología, Hospital de Sant Pau, Barcelona, Catalunya, Spain
4. Department of Speech, Language, and Hearing Sciences, California State University, East Bay, Hayward, CA, USA.
5. Department of Psychiatry, University of California, San Diego, USA
6. Department of Linguistics, Northwestern University, Evanston, IL, USA.
7. The Graduate Center and Lehman College, City University of New York, New York, NY, USA.

***corresponding author, sries@sdsu.edu**

Introduction

Bilingualism is the norm rather than the exception (Grosjean 2010), but only about 1% of aphasia studies have focused on bilinguals. A possible reason is the difficulty in accounting for the numerous factors known to influence bilingual experience, including age-of-acquisition, relative language dominance, or patterns of language use (de Bruin 2019). Consequently, patterns of language impairment following brain damage are diverse (Kuzmina et al. 2019): while bilinguals' languages often demonstrate parallel impairments, one language is sometimes more impaired than the other. Compounded with this variability are the linguistic and cognitive changes brought by aging in bilinguals (Bialystok et al. 2004; Gollan et al. 2024). This symposium regroups four lines of bilingual aphasia research, including stroke-induced aphasia, primary progressive aphasia (PPA), Alzheimer's Disease, and aging, providing a comprehensive lay of the land in bilingual aphasia research today.

Structure

4 15 mins talks, 2 mins of questions each + 12 mins general discussion.

Session 1: Cognate processing in bilinguals with aphasia - Higby

Bilinguals exhibit cross-linguistic influence between their languages, resulting in facilitation or interference (Bailey et al., 2024). Cognates are typically processed and produced more quickly and accurately than non-cognate words. However, cognates can also produce interference in some contexts (Vanlangendonck et al., 2020). We investigate cross-linguistic influences in bilinguals with aphasia through cognate facilitation and interference, and whether cognitive control abilities predict cognate interference control.

Session 2: Morphological impairment in bilinguals with stroke-related aphasia - Goral

Nonfluent aphasia is characterized by reduced sentence structure and difficulties with morphosyntax, including conjugation. Whether language-specific characteristics influence the manifestation of difficulty in aphasia has been a matter of debate (Bates et al., 1991; Fyndanis et al., 2023). We examine verb, noun, and adjective retrieval and conjugation performance in bilinguals with nonfluent aphasia. Findings are consistent with previous reports that the "same" aphasia can manifest differently in different languages (Bates et al., 1991).

Session 3: Advancing Assessment and Intervention in Bilingual Primary Progressive Aphasia - Grasso and Santos Santos

We present novel findings showing that analysis of connected speech samples can distinguish between PPA variants in bilingual speakers, and report significant within-language gains and robust cross-language transfer using tailored naming and script training interventions. These findings offer promising pathways toward more inclusive, evidence-based care for bilingual individuals with PPA.

Session 4: Language Switching across the Lifespan - Gollan and Goldrick

Bilinguals rarely switch languages by mistake but such *intrusion errors* can be elicited reliably in the lab and provide powerful evidence about the nature of bilingual language selection. While some forms of control seem to be automatic and remain robust in aging, and even in bilinguals with Alzheimer's disease, other forms of control exhibit decline in a manner reminiscent of domain general aging deficits in proactive control. This evidence suggests a robust multi-faceted system that ensures tight control over language selection by relying on a combination of language specific and domain general cognitive control mechanisms.

Interest to the Academy

This symposium is relevant for the Academy given the paucity of research on bilingual aphasia. These talks will present research in bilingual aphasia examining several cognitive and linguistic processes, providing a comprehensive overlook of how different linguistic processes can be impacted in bilinguals with aphasia.

Selected References

- Bailey, L., Lockary, K., & Higby, E. (2024). Cross-linguistic influence in the bilingual lexicon: Evidence for ubiquitous facilitation and context-dependent interference effects on lexical processing. *Bilingualism: Language and Cognition*, 27(3), 495-514. <https://doi.org/10.1017/S1366728923000597>
- Bates, Elizabeth, Wulfeck, Beverly, and MacWhinney, Brian. (1991). Cross-linguistic research in aphasia: An overview. *Brain and Language*, 41(2), 123-148.
- Bialystok, Ellen, Fergus I. M. Craik, Raymond Klein, and Mythili Viswanathan. 2004. "Bilingualism, Aging, and Cognitive Control: Evidence from the Simon Task." *Psychology and Aging* 19(2):290–303. doi:10.1037/0882-7974.19.2.290.

- de Bruin, Angela. 2019. "Not All Bilinguals Are the Same: A Call for More Detailed Assessments and Descriptions of Bilingual Experiences." *Behavioral Sciences (Basel, Switzerland)* 9(3):33. doi:10.3390/bs9030033.
- Fyndanis, V., Miceli, G., Capasso, R., Killmer, H., Malefaki, S., and Grohmann, K. (2023). Production of sentential negation in German and Italian non-fluent aphasia. *Journal of Psycholinguistic Research*, 52, 497-524. <https://doi.org/10.1007/s10936-022-09894-4>
- Gollan, Tamar H., Dalia L. Garcia, Mayra Murillo, Jocelyn Vargas, Brandon Pulido, and David P. Salmon. 2024. "Sprinting in Two Languages: Picture Naming Performance of Older Spanish-English Bilinguals on the Multilingual Naming Test Sprint 2.0." *Neuropsychology* 38(7):653–64. doi:10.1037/neu0000958.
- Grosjean, François. 2010. *Bilingual: Life and Reality*. Cambridge, MA, US: Harvard University Press.
- Kuzmina, Ekaterina, Mira Goral, Monica Norvik, and Brendan S. Weekes. 2019. "What Influences Language Impairment in Bilingual Aphasia? A Meta-Analytic Review." *Frontiers in Psychology* 10:445. doi:10.3389/fpsyg.2019.00445.
- Vanlangendonck, F., Peeters, D., Rueschemeyer, S.-A., & Dijkstra, T. (2020). Mixing the stimulus list in bilingual lexical decision turns cognate facilitation effects into mirrored inhibition effects. *Bilingualism: Language and Cognition*, 23, 836-844. <https://doi.org/10.1017/S1366728919000531>

The Lived Experiences of Chinese-Speaking Individuals with Aphasia: Implications for Clinical Practice

Preeti Rishi^{1*}, Yusheng Wang¹, Emily Zhang⁴, Xi Zhao^{2,4}, Audrianna Leung^{3,4},
Tracy Love^{1,4}, Henrike K. Blumenfeld^{1,4}

¹ Joint Doctoral Program in Language and Communicative Disorders, San Diego State University/University of California San Diego, San Diego, California, USA

² Torrey Pines High School, San Diego, CA, USA

³ Westview High School, San Diego, CA, USA

⁴ School of Speech, Language, and Hearing Sciences, San Diego State University, San Diego, California, United States

*corresponding author, prishi3933@sdsu.edu

Introduction

Aphasia is a language disorder resulting from acquired brain injury that significantly impacts quality of life (Howe et al., 2008). The etiology of the injury (e.g., stroke, traumatic brain injury [TBI]) may influence psychosocial outcomes (Tateno et al., 2002). While most aphasia research is quantitative in nature, qualitative studies are essential for understanding the lived experiences of individuals with aphasia (IWA), especially from culturally and linguistically diverse backgrounds (Simmons-Mackie & Lynch, 2013). This study explores the experiences of Chinese-speaking IWA living in the U.S., with emphasis on psychosocial changes, service satisfaction, and cultural-linguistic considerations across different etiologies (TBI, stroke-induced). We hypothesize that language and cultural affiliation will shape participants' experiences in an English-dominant context.

Methods

Five in-depth virtual interviews were conducted with multilingual Chinese-speaking IWA in the U.S. Three interviews have been fully analyzed, with all five expected to be completed by the conference. Participant demographics can be found in Table 1. Interviews followed a semi-structured, aphasia-friendly, and bilingual interview guide (see Figure 1; Wilson & Kim, 2021). Sessions were recorded, transcribed, and analyzed using thematic analysis that involved data familiarization, initial coding, and theme/subtheme generation (Braun & Clarke, 2006).

Results

Preliminary analysis of three interviews revealed three key themes that will be further examined within case clusters (ischemic, hemorrhagic, TBI):

1. **Psychosocial effects of aphasia:** Participants described major emotional and social shifts, including depression, frustration, identity loss, and changes in relationships. Emotional adjustment varied, with strong support systems aiding recovery. Aphasia limited expression of personality, social engagement, and familial roles, often leading to feelings of isolation. Shifts in family dynamics, such as losing household roles, further reduced autonomy and belonging.
Experiences with clinical services: Dissatisfaction with one-on-one speech

therapy was common, driven by limited time, lack of language-specific support, and difficulties establishing trust with providers. Conversation groups, particularly those conducted in native languages, were identified as critical for emotional wellbeing and community-building; however, awareness of these groups varied, with some participants unaware of available resources.

2. **Cultural and Linguistic Factors:** Stigma around disability in Asian cultures shaped participants' willingness to disclose their condition or seek help, further contributing to social withdrawal (Kramer et al., 2002). Language barriers and limited aphasia awareness among family and friends added to participants' challenges. Additional stressors, such as immigration-related concerns, were noted.

Full analysis of all five interviews will provide deeper insights into these emerging themes.

Conclusions

Psychosocial changes following aphasia onset are profound and must be addressed in clinical care. The varied etiologies as well as size and extent of injury in this sample, including ischemic stroke, hemorrhagic stroke, and TBI, may contribute to these effects. Understanding the unique experiences of Chinese-speaking IWA can help speech-language pathologists anticipate needs and tailor services for this cultural group. Clinicians should adopt client-centered, culturally responsive approaches that support both linguistic and emotional wellbeing. Building trust, aligning therapy to client goals, and providing accessible bilingual resources are crucial for satisfaction and recovery. Referrals to mental health services and support groups may foster holistic rehabilitation. Greater clinician awareness of the intersection of language, culture, and identity is essential to improving outcomes for Chinese-speaking IWA and other less well-represented populations.

References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Howe, T. J., Worrall, L. E., & Hickson, L. M. H. (2008). Observing people with aphasia: Environmental factors that influence their community participation. *Aphasiology*, 22(5), 618–643.
- Kramer, E. J., Kwong, K., Lee, E., & Chung, H. (2002). Cultural factors influencing the mental health of Asian Americans. *Western Journal of Medicine*, 176(4), 227–231.
- Simmons-Mackie, N., & Lynch, K. E. (2013). Qualitative research in aphasia: A review of the literature. *Aphasiology*, 27(11), 1281–1301.
- Tateno, A., Murata, Y., & Robinson, R. G. (2002). Comparison of cognitive impairment associated with major depression following stroke versus traumatic brain injury. *Psychosomatics*, 43(4), 295–301. <https://doi.org/10.1176/appi.psy.43.4.295>
- Wilson, C., & Kim, E. S. (2021). Qualitative data collection: Considerations for people with aphasia. *Aphasiology*, 35(3), 314–333. <https://doi.org/10.1080/02687038.2019.1693027>

Acknowledgments

This work was supported by the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health under grant number T32DC007361-16 (PR; PI: Love) as well as a San Diego State University College of Health and Human Services Graduate Student Research Award to PR.

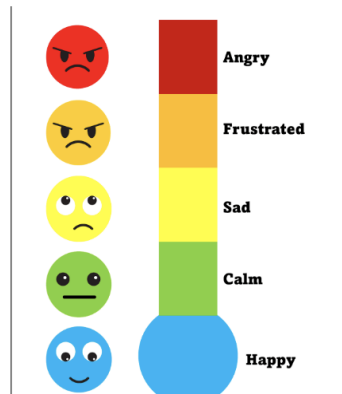
Table 1. Participant Demographics. All participants were of Asian descent and identified culturally as both Chinese and American.

Demographic Variable	Participant 1	Participant 2	Participant 3	Average
Age	58	55	33	48.7
Sex	Female	Female	Female	
Years of Education & Highest Education Level	16 – College	19 – Master's	17 - College	17.3
Location	California	California	Virginia	
Languages Known (in order of acquisition)	Mandarin, Taiwanese, Cantonese, English, Shanghainese	Cantonese, Hakka, Mandarin, English, Spanish	Shanghainese, Cantonese, Mandarin, English	
Immigration Age to the US	18	17	17	17.3
Cause of Aphasia	Ischemic Stroke	Hemorrhagic Stroke	Traumatic Brain Injury	
Years Post-Onset of Aphasia	2	4	6	4

Note. Participant 4 - hemorrhagic stroke (AVM rupture); Participant 5 - hemorrhagic stroke.

Figure 1. Sample Question from the Semi-Structured Interview Guide. Each question from the semi-structured interview guide was written in English and in Traditional or Simplified Chinese, based on the participant's self-reported preference. Key parts of each question were bolded. Graphics were included to support comprehension and formulation of responses. Sentence starters were provided in red text to help participants initiate their response. The interview guide was shared with participants in advance to aid preparation of responses. During the session, the guide was screen-shared via Zoom so that participants' comprehension could be aided by seeing the visual aids, reading the question, and hearing the experimenter read the question out loud.

- (6) Tell me about your **thoughts and feelings** when you learned that you had aphasia.
 請您告訴我，當您得知您有失語症時的**想法和感受**。



When I learned I had aphasia, I felt _____ because...

Control Group Design Shapes Treatment Effects in Aphasia Randomized Controlled Trials: Insights from a Systematic Review and Meta-Analysis

Marissa Russell-Meill^{*1}, Alexandra Piper-Wagner¹, Marian Brady², Caterina Breitenstein³, Katerina Hilari⁴, & Swathi Kiran¹

¹Center for Brain Recovery, Boston University, MA, USA

²Glasgow Caledonian University, Scotland, UK

³Dept. of Neurology, University of Münster, Germany

⁴City St George's University of London, England, UK

***corresponding author, mruss@bu.edu**

Introduction

While considerable attention has focused on aphasia interventions in randomized controlled trials (RCTs; Brady et al., 2016), control group design remains underexplored, despite its critical role in establishing treatment efficacy (Hayward et al., 2024). Findings from other clinical fields suggest comparator choice influences trial outcomes (e.g., Gold et al., 2017; Mohr et al., 2014). We evaluate whether control group selection moderates effect sizes in RCTs evaluating language interventions for post-stroke aphasia.

Methods

We conducted a systematic review, categorizing studies into nine predefined control group types (Figure 1): no treatment, waitlist, social support, activity control, two forms of usual care (unrestricted, protocolized), and three active comparators (differing by theoretical approach, delivery model, or regimen). Standardized mean differences (Hedges' g) quantified effect sizes for each experimental intervention relative to its control group. Meta-analyses were conducted across various outcome domains; aphasia severity, expressive language, and receptive language are reported here. Within each domain, random-effects models pooled effect sizes across studies using the same control group type, and Q-tests evaluated the significance of differences between these subgroups.

Results

Our review identified 5,274 records, with 78 RCTs meeting inclusion criteria for meta-analysis. Control group type significantly influenced trial-level effect sizes across domains ($Q=21.30-22.09$, $p=.01$). Protocolized usual care (29.3% of trials) yielded the largest effects ($g=0.39-0.66$), while trials using unrestricted usual care comparators (7.3%) showed negative effects ($g=-0.15--0.03$).

Trials using theoretical active comparators (23.2%) showed near-zero effect sizes ($g=-0.03-0.02$), while delivery model (8.7%) and regimen comparators (8.5%) yielded variable effects ($g=0.06-0.28$ and $g=-0.63-0.32$, respectively). Social support (6.1%, $g=0.08-0.36$) and activity controls (3.7%, $g=0.08-0.13$) produced small-to-moderate effect. No-treatment (8.5%) and waitlist (4.9%) trials showed variable outcomes ($g=-0.12-0.38$). Several subgroups comprised few studies ($k=1-4$), resulting in wide confidence intervals.

Conclusions

Control group choice moderates estimates of aphasia treatment efficacy. Our results demonstrated that the term "usual/standard care" conceals critical differences: protocolized usual care consistently led to larger effect sizes, while unrestricted care – though represented by fewer studies – revealed negative effects. Surprisingly, protocolized care allowed for larger observed effects than active comparators, challenging the assumption that controls receiving language intervention inherently diminish effect sizes. One explanation is that protocolized care was typically individualized, producing broad group-level gains, whereas active comparators targeted the same language functions as experimental treatments, reducing between-group contrasts.

Although based on fewer studies, other control group types also yielded insights. Effects for passive controls (no treatment, waitlist) were variable, likely due to implementation differences (e.g., compliance monitoring). These designs have been shown to enhance between-group contrasts and effect sizes (Mohr et al., 2014), motivating future investigation. Social support and activity controls produced small-moderate effect sizes relative to other control types, highlighting their potential to isolate specific therapeutic benefits from general engagement (e.g., attention, social interaction) – a distinction commonly used in other clinical fields.

These findings highlight the importance of clearly defining allowable control group activities in advance and aligning comparator selection with trial phase and research objectives to strengthen the evidence base guiding aphasia rehabilitation.

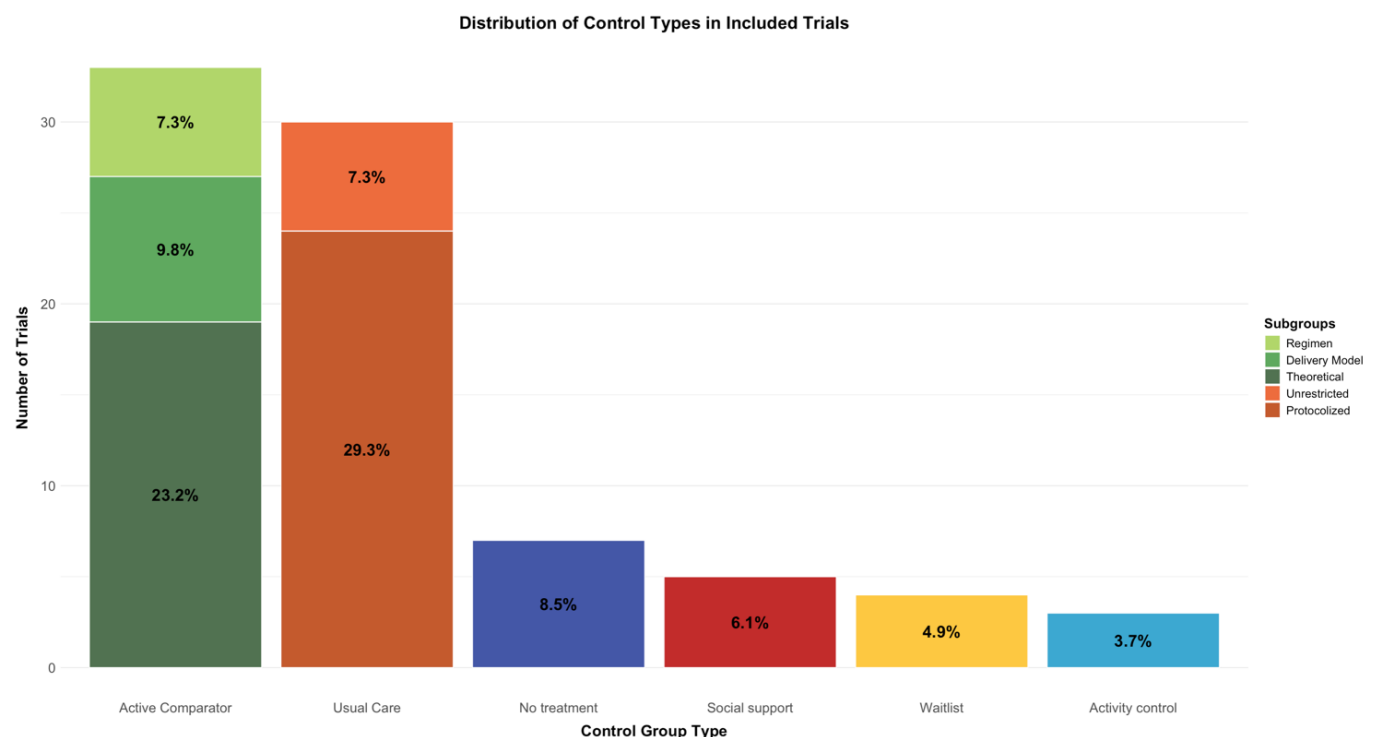
References

- Brady, M., Kelly, H., Godwin, J., Enderby, P., & Campbell, P. (2016). Speech and language therapy for aphasia following stroke. *Cochrane Database of Systematic Reviews*, 2016(6), Article CD000425.
<https://doi.org/10.1002/14651858.cd000425.pub4>
- Gold, S. M., Enck, P., Hasselmann, H., Friede, T., Hegerl, U., Mohr, D. C., & Otte, C. (2017). Control conditions for randomised trials of behavioural interventions in psychiatry: A decision framework. *The Lancet Psychiatry*, 4(9), 725–732.
[https://doi.org/10.1016/S2215-0366\(17\)30153-0](https://doi.org/10.1016/S2215-0366(17)30153-0)
- Hayward, K., Dalton, E. J., Barth, J., Brady, M., Cherney, L. R., Churilov, L., Clarkson, A. N., Dawson, J., Dukelow, S. P., Feys, P., Hackett, M., Zeiler, S. R., & Lang, C. E. (2024). Control intervention design for preclinical and clinical trials: Consensus-based core recommendations from the third Stroke Recovery and Rehabilitation Roundtable. *International Journal of Stroke*, 19(2), 169–179.
<https://doi.org/10.1177/17474930231199336>
- Mohr, D., Ho, J., Hart, T., Baron, K., Berendsen, M., Beckner, V., Cai, X., Cuijpers, P., Spring, B., Kinsinger, S., Schroder, K., & Duffecy, J. (2014). Control condition design and implementation features in controlled trials: A meta-analysis of trials evaluating psychotherapy for depression. *Translational Behavioral Medicine*, 4(4), 407–423. <https://doi.org/10.1007/s13142-014-0262-3>

Acknowledgments

Marissa Russell-Meill was supported by T32 DC013017

Figure 1. Distribution of control group types in included trials



Note: Percentages reflect the proportion of trials using each control group type relative to the total number of included trials. Control groups were defined a priori as follows: (1) **No treatment** – participants receive no study-related intervention during the trial period; (2) **waitlist (alone)** – no treatment during the study, with experimental intervention offered post-assessment; (3) **Usual care** – categorized as (a) **unrestricted**: participants access any routine clinical care or community service without study-imposed restrictions, and (b) **protocolized**: participants receive a standardized, structured intervention reflecting typical clinical practice without introducing novel content (e.g., impairment-based therapy using established methods); (4) **Social support** – structured activities providing interaction and communication opportunities without therapeutic intent; (5) **Active comparator** – an alternative language-focused intervention, further classified as differing by (a) theoretical approach (e.g., semantic vs. phonological), (b) delivery model (e.g., clinician- vs. technology-delivered), or (c) regimen (e.g., intensive vs. standard dosing); (6) **Activity control** – dose-matched non-therapeutic tasks designed to control for general cognitive engagement without targeting language function.

Table 1. Summary of subgroup analyses by control group category

Control Group Type	Outcome Domain		
	Aphasia Severity (k, g [95% CI])	Expressive Language (k, g [95% CI])	Receptive Language (k, g [95% CI])
Usual Care (Protocolized)	17, 0.66 [0.16, 1.16]	18, 0.39 [0.20, 0.58]	15, 0.44 [0.19, 0.69]
Usual Care (Unrestricted)	2, -0.15 [-0.84, 0.54]	4, -0.03 [-0.19, 0.13]	3, -0.11 [-1.43, 1.21]
Active Comparator (Theoretical)	7, 0.02 [-0.30, 0.35]	15, -0.03 [-0.21, 0.15]	9, -0.02 [-0.24, 0.20]
Active Comparator (Delivery Model)	7, 0.06 [-0.25, 0.38]	5, 0.16 [-0.24, 0.56]	5, 0.28 [-0.28, 0.84]
Active Comparator (Regimen)	4, 0.32 [-1.53, 1.92]	4, 0.01 [-2.78, 2.79]	1, -0.63 [-1.98, 0.72]
No Treatment	2, -0.12 [-1.14, 0.89]	4, 0.18 [-0.49, 0.85]	3, 0.37 [-0.58, 1.32]
Waitlist (Alone)	1, 0.38 [-0.06, 0.81]	4, -0.01 [-0.41, 0.40]	3, 0.19 [-0.84, 1.22]
Social Support	2, 0.08 [-1.40, 1.55]	3, 0.36 [-0.38, 1.10]	2, 0.31 [0.15, 0.47]
Activity Control	2, 0.13 [-3.36, 3.62]	3, 0.10 [-0.88, 1.09]	2, 0.08 [-1.18, 1.34]
Subgroup Differences (Q, p)	21.30, .01	21.88, .01	22.09, .01

Note. k = number of studies within each subgroup; g = pooled Hedge's g (positive values indicate greater improvement in experimental group compared to the control group); CI = Confidence Interval; Q = test statistic for subgroup differences. P-values have been corrected for multiple comparisons using the Benjamini-Hochberg procedure.

Written Multiplication and Subtraction in Aphasia: a voxel-based lesion-symptom mapping.

Elena Salillas^{1,2*}, Maria Varkanitsa³, David Fernández², Swathi Kiran³ and Carlo Semenza⁴

¹ Department of Psychology and Sociology, University of Zaragoza, Zaragoza, Spain

² Faculty of Social and Human Sciences, Teruel, Spain

³ Center for Brain Recovery, Boston University, Boston, US

⁴ Padova Neuroscience Center, University of Padova, Italy

*corresponding author: esalillas@unizar.es

Introduction

Math performance in aphasia implies preserved language and mathematical systems (Proios et al., 2021). Research on complex written calculation is limited, and its brain basis is unknown (Arsalidou & Taylor, 2011; Istomina & Arsalidou, 2024; Menon, 2014). These operations incorporate learned procedures into mental calculation, as carrying and borrowing require an understanding of place value and adjusting digits in columns. Additional factors include operator size and problem size, as well as spatial and motor components. This study aims to characterize calculation performance among aphasic patients and identify lesion locations linked to potential deficits. Voxel-based lesion-symptom mapping (VLSM) related written calculation errors to lesion location, guided by item classification analyses.

Methods

Thirty aphasic patients (4 female; average age, 56.9; SD, 10.3; average months post-onset, 93.9; SD, 101.3) with left-hemisphere lesions performed written multiplication and subtraction using paper and pencil and typed answers. Most were anomic (20), with five Broca aphasics (WAB-R). Items were classified by three criteria: (1) base-10 operators (two decades or hundreds); (2) digits in the correct solution (1-2 or 3-4); (3) number of carries/borrows (0 or 1-2). MRI lesion maps were linked to error proportions for each item type using NiiStat (Figures 1A to 1C). Over-threshold Z-maps ($Z > 5$, or $Z > 4.2$ for criterion 1) were quantified in the distribution of white and grey matter (FSL *autoaq*; Figure 1D and Table 1).

Results

The VLSM analysis revealed an involvement of more extensive sub-parietal white matter in *simpler operations* (decade operands, zero carries, or results of 1 or 2 digits). The primary related tract with errors in operations involving no carries was the superior longitudinal fasciculus (SLF). The SLF and the inferior longitudinal fasciculus (ILF) in its occipitoparietal part were associated with errors involving fewer digits in the result. The cingulum was associated with simpler (decades) operators. Errors in *complex operations* (more carries, more digits in the result, or hundreds as operands) were mainly linked to lesions in the cerebrosplinal tract (CST) and sensorimotor areas. *Simpler operations* were consistently associated with damage in the superior parietal lobule (SPL), except for a role of the angular gyrus (AG) in results with fewer digits. Notably, simpler operations were associated with lesions in the horizontal parts of the intraparietal sulcus (hIPS, parts 1 and/or 3). Damage to the peri-Rolandic gyri, as well as the SPL, was associated with *complex calculations*.

Conclusions

Results support the involvement of parietal and peri-Rolandic areas in complex written calculations. Only aphasic patients with damage in these areas are impeded in the process, implying a role for the CST. Hence, the complexity of the problem increases the use of the sensorimotor system. Damage to larger regions, including the left hIPS, and more extensive disruption of white matter impairs simpler problems. In turn, worse performance is associated with more extensive lesions. However, complex written calculations are still hindered with preserved left hIPS, if the SPL is damaged, likely due to increased difficulties with spatial computations.

References

- Arsalidou, M., & Taylor, M. J. (2011). Is $2+2=4$? Meta-analyses of brain areas needed for numbers and calculations. *NeuroImage*, 54(3), 2382–2393.
<https://doi.org/10.1016/j.neuroimage.2010.10.009>
- Istomina, A., & Arsalidou, M. (2024). Add, subtract and multiply: Meta-analyses of brain correlates of arithmetic operations in children and adults. *Developmental Cognitive Neuroscience*, 69. <https://doi.org/10.1016/J.DCN.2024.101419>
- Menon, V. (2014). Arithmetic in the Child and Adult Brain. In R. Cohen Kadosh & A. Dowker (Eds.), *The Oxford Handbook of Numerical Cognition* (Vol. 1, pp. 502–530). Oxford University Press.
<https://doi.org/10.1093/OXFORDHB/9780199642342.013.041>
- Proios, H., Tsakpounidou, K., Karapanayiotides, T., Priftis, K., & Semenza, C. (2021). Aphasia and Math: Deficits with Basic Number Comprehension and in Numerical Activities of Daily Living. *Journal of the International Neuropsychological Society*, 27(9), 939–951.
<https://doi.org/10.1017/S1355617720001368>

Figure 1. VLSM Results. A to C: VLSM results for the three item classification criteria. D: Generated over threshold mask to compute the voxel quantification and location using autoaq (Table 1).

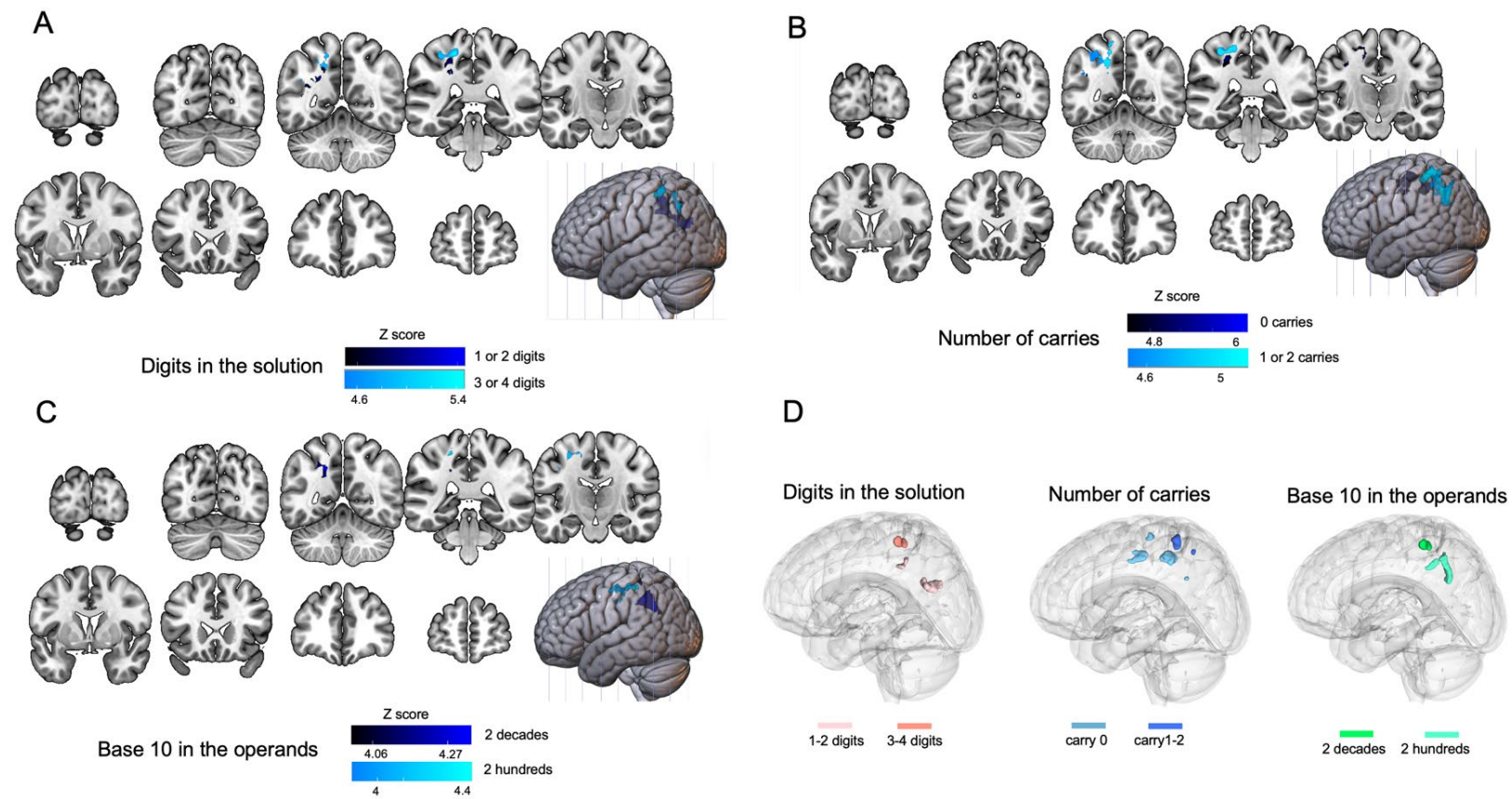


Table 1. Voxel Quantification and Location

ITEM ANALYSIS		cluster#	size	Number of voxels (overthreshold and Z>5) per cortical area restricted to parietal cortex and to white matter association tracts														
				PreC	PostC	AG	SMG	SPL	PREC	HIPS1	HIPS2	HIPS3	SLF	ILF	IFOF	CING	CC	CST
Number of carries	Operations with no carry	3	254	0,31	22,86	0,00	5,85	13,70	0,00	3,62	0,54	19,09	17,93	0,00	0,00	0,00	0,00	4,31
		2	110	0,21	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	0,00	0,00	0,00	0,00	0,00
		1	31	8,76	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,16
		TOTAL	395	9,27	22,86	0,00	5,85	13,70	0,00	3,62	0,54	19,09	18,07	0,00	0,00	0,00	0,00	5,47
	Operations with 1 or 2 carries	2	166	3,49	54,34	0,00	4,37	14,33	0,00	0,00	0,00	0,00	1,14	0,00	0,00	0,00	0,00	6,90
		1	11	0,00	0,17	0,00	0,00	1,98	2,04	0,00	0,00	0,28	0,00	0,00	0,00	0,06	0,00	0,00
		TOTAL	177	3,49	54,51	0,00	4,37	16,31	2,04	0,00	0,00	0,28	1,14	0,00	0,00	0,06	0,00	6,90
Problem size in terms of number of digits in the correct solution	Results of 1 or 2 digits	3	235	0,00	0,00	2,84	0,00	0,00	0,41	10,21	0,81	0,57	2,92	4,46	3,81	0,00	0,00	0,00
		2	27	0,00	0,00	0,00	0,41	0,00	0,00	0,95	0,00	0,00	1,08	0,00	0,00	0,00	0,00	0,14
		1	15	0,00	0,30	0,00	0,05	0,05	0,05	0,10	0,00	0,10	0,40	0,00	0,00	0,00	0,00	0,05
		TOTAL	277	0,00	0,30	2,84	0,45	0,05	0,46	11,26	0,81	0,67	4,40	4,46	3,81	0,00	0,00	0,18
	Results of 3 or 4 digits	1	155	9,97	37,27	0,00	1,15	4,38	0,00	0,00	0,00	0,00	1,15	0,00	0,00	0,00	0,00	5,32
		TOTAL	155	9,97	37,27	0,00	1,15	4,38	0,00	0,00	0,00	0,00	1,15	0,00	0,00	0,00	0,00	5,32
Operations involving decades or hundreds	Operations on 2 decades	2	240	0,00	0,30	0,00	1,05	16,27	7,95	5,17	0,00	11,70	1,05	1,73	0,37	5,40	0,00	0,00
		1	53	0,53	1,06	0,00	0,00	0,00	2,98	0,00	0,00	0,00	0,00	0,00	0,00	1,39	0,00	0,00
		TOTAL	293	0,53	1,36	0,00	1,05	16,27	10,93	5,17	0,00	11,70	1,05	1,73	0,37	6,79	0,00	0,00
	Operations on 2 hundreds	1	156	10,04	37,51	0,00	1,15	4,41	0,00	0,00	0,00	0,00	1,15	0,00	0,00	0,00	0,00	5,36
		TOTAL	156	10,04	37,51	0,00	1,15	4,41	0,00	0,00	0,00	0,00	1,15	0,00	0,00	0,00	0,00	5,36

PreC = Precentral; PostC= Postcentral; AG= Angular Gyrus; SMG = Supramarginal Gyrus; SPL= Superior Parietal Lobule; HIPS= Horizontal Intraparietal Sulcus; SLF= Superior Longitudinal Fasciculus; ILF= Inferior Longitudinal Fasciculus; IFOF= Inferior Fronto-Occipital Fasciculus; CING= Cingulus; CC= Corpus Callosum; CST= Cerebrospinal Tract. HIPS locations are the only areas taken from the Juelich atlas. The remaining ones are sourced from the Harvard-Oxford Cortical Structural Atlas and the JHU White Matter Tractography Atlas.

Addressing Ecological Validity in Aphasia through Dual- and Multi-tasking Research: Recent Advances

Christos Salis^{1*}, Laura L. Murray², Tyson G. Harmon³, Jacqueline Hinckley⁴, Janet Patterson⁵, and Stephanie Karidas⁶

¹Speech & Language Sciences, Newcastle University, Newcastle upon Tyne, UK

²Communication Sciences and Disorders, Western University, London, ON, Canada

³Communication Disorders, Brigham Young University, Provo, UT, USA

⁴Speech Language Pathology, Nova Southeastern University, Fort Lauderdale, FL, USA

⁵VA Northern California Health Care System, Martinez, CA, USA

⁶Speech Language Pathology, Brescia University, Owensboro, KY, USA

***corresponding author, christos.salis@newcastle.ac.uk**

Introduction

Most of what we know about language and broader cognition in people with aphasia comes from studies that have used the neuropsychological assessment paradigm (e.g., confrontation naming, picture description). Typically, such assessments sample behavior within distraction-free settings (e.g., clinic rooms), which rarely resemble the hustle and bustle of everyday life, thus diminishing the ecological validity of the findings (cf., Pinto et al., 2025). This limitation can be addressed to some extent with dual- and multi-task paradigms in which people carry out two or more tasks simultaneously (e.g., talking while walking). Performance in a measure of primary interest during the dual/multi-task condition is then compared to a different, less complex condition (e.g., talking while seating), yielding information about how the measure of primary interest may or may not be affected by a complex condition, commonly encountered in daily contexts. This symposium will provide overviews of recent studies utilizing dual/multi-task paradigms to inform our understanding of aphasia from this perspective.

Structure

Session 1

Salis will outline the findings of two recent systematic reviews on language-specific dual-task studies in typical aging (Salis et al., in press), stroke and stroke-related aphasia (Salis et al., 2023), focusing on key dual-task paradigms that have been used in these literature domains and methodological issues. He will also outline a language-based dual/multi-task taxonomy, informed by related work in physical therapy (McIsaac et al., 2015).

Session 2

Harmon will review quantitative and qualitative findings comparing how various dual-task conditions (e.g., tone discrimination, energetic noise, informational noise) impact spoken language during narrative discourse for adults with and without aphasia (Harmon et al., 2019, 2024; Nelson et al., 2023). He will then discuss current ongoing work to establish normative data for similar dual-task speaking conditions (e.g., talking while responding to or in the presence of noise) that may serve to facilitate ecologically valid assessment of people with aphasia individually (Harmon et al., under review).

Session 3

Hinckley will summarize her work with Patterson and Karidas that developed a multitasking assessment based on an everyday task (Hinckley et al., 2024; Hinckley et al., 2022; Karidas & Hinckley, 2020). The assessment has been used with people with aphasia and is related to specific language and other cognitive performances (Hinckley et al., 2024). The team will also highlight how a multitasking assessment can measure important treatment outcomes that are infrequently captured (Hinckley et al., in progress; Hinckley et al., 2001; Hinckley & Carr, 2005).

Interest to the Academy

Ecological validity is a common challenge for clinicians and researchers who specialize in aphasia, including many who attend the Academy's meetings. The dual/multi-task paradigm has the potential to bridge basic science with real-world applications. The symposium will enable attendees to reflect on the translational challenges they may face regarding the ecological validity of the knowledge they create. It may also trigger their curiosity to discover more about the rather large, albeit not mainstream, dual/multi-task literature and possibly influence them to use such methods for generating converging evidence for the research questions they seek to answer.

Selected References

- Harmon, T. G., Jacks, A., Haley, K. L., & Bailliard, A. (2019). Dual-task effects on story retell for participants with moderate, mild, or no aphasia: Quantitative and qualitative findings. *Journal of Speech, Language, and Hearing Research*, 62(6), 1890-1905.
- Harmon, T. G., Hegewald, R., & Dromey, C. (2024). "Competing Noises": How background noise impacts the communication experiences of people with mild- to-moderate aphasia. *American Journal of Speech-Language Pathology*, 33(6S), 3393-3409.
- Hinckley, J., Patterson, J., & Karidas, S. (2024). A multitasking assessment for aphasia: The Catalog Ordering Task. *Applied Neuropsychology: Adult*, 16, 1-12.
- Nelson, B. S., Harmon, T. G., Dromey, C., & Clawson, K. D. (2023). Telling stories in noise: The impact of background noises on spoken language for people with aphasia. *American Journal of Speech-Language Pathology*, 32(5S), 2444-2460.
- Pinto, J. O., Dores, A. R., Peixoto, B., & Barbosa, F. (2025). Ecological validity in neurocognitive assessment: Systematized review, content analysis, and proposal of an instrument. *Applied Neuropsychology: Adult*, 32, 577-594.
- Salis, C., Jarrar, R., & Murray, L. L. (2023). Language specific dual-task effects after stroke: A systematic review. *Journal of Speech, Language, and Hearing Research*, 66, 2858-2883.

Acknowledgments

We would like to thank the people with aphasia, other participants, and collaborators who made the research presented in this symposium possible.

From Sentence to Discourse to Conversation: A Novel Therapy for People with Mild Aphasia

Julie Schlesinger^{1*}, Leslie Vnenchak², Joseph Sheridan², Harris Drachman²,
Nadine Martin¹, and H. Branch Coslett²

¹ Communication Sciences and Disorders, Temple University, Philadelphia, PA, USA

² Department of Neurology, University of Pennsylvania School of Medicine,
Philadelphia, PA, USA

*corresponding author, julie.schlesinger@temple.edu

Introduction

Although mild post-stroke aphasia is often disabling, there are no accepted treatments for this condition. Current standardized assessments of aphasia (e.g., Western Aphasia Battery, WAB-R; Kertesz, 2006) are appropriate for moderate-to-severe language impairment but are insensitive to changes in people with mild aphasia (PWMA) (Fromm et al., 2017; Silkes et al., 2021). The participants in this study are those whose language function would be judged “normal” or mildly impaired (defined here as WAB-R Aphasia Quotient > 85), but who experience life-altering disorders in functional communication contexts such as conversation (Cavanaugh et al., 2020). PWMA often show greater communication difficulty with longer, more complex sentences and discourse tasks (Graham et al., 2006), which increase the verbal short-term working memory (STM/WM) load in different ways.

Our therapy protocol combines a cognitive-linguistic treatment with transcranial magnetic stimulation (TMS). Here, we report pilot data from the language treatment, which draws from three evidence-based cognitive-linguistic theories. The first, “conversational alignment” (Garrod & Pickering, 2004), occurs via lexical (Brennan & Clark, 1996) and structural (Pickering & Ferreira, 2008) priming between interlocutors in a dialogue. The second involves temporal properties of lexical activation, which are impaired in aphasia (Martin et al., 2018) and revealed when response delays or increases in memory load are embedded in verbal tasks. Under such conditions, PWMA, who otherwise perform well on word-level tasks, show reduced accuracy compared to control performance. Third, we used a modified form of Constraint-Induced Language Therapy (mCILT; Pulvermüller et al., 2001) to structure treatment delivery: intense practice encouraging use of verbal language over nonverbal to communicate.

Methods

Participants. This report focuses on behavioral data from the first two completed participants of an ongoing study.

Treatment schedule: 5 days per week, 2 consecutive weeks.

Treatment involved one hour of tasks reflecting different aspects of discourse, aiming to improve conversational communication.

1. Repetition of lengthy sentences with complex structures after a 5-second delay provided practice with response delay and verbal STM.
2. Self-generated topic-based monologues provided practice with initiation of discourse.

3. Structured question and answer conversation provided an opportunity to move from self-generated language toward dialogue.
4. Conversational tasks using AI-generated prompts expanded dialogue practice toward more natural unstructured conversation with the examiner.

Outcome Measures. Subtests from the Temple Assessment of Language and Short-term memory in Aphasia (TALSA; Martin et al., 2018) administered before and after therapy:

Primary: Delayed sentence repetition with high memory load.

Secondary: Single word tasks with response delays and manipulation of memory load, discourse sample analyses, and quality-of-life measures.

Results

(Table 1) Scores on single word tasks are near ceiling. For both participants, performance on two STM/WM tasks, rhyming and synonymy triplets, improves after treatment, as do Quality-of life measurements. For Participant 2, repetition of long sentences after a response delay improves post-treatment.

Conclusions

This treatment stimulated improvement in measures of STM/WM for both participants and repetition of lengthy sentences after a response delay for Participant 2. Further analyses of discourse samples will be completed, and these findings and their implications will be discussed.

References

- Brennan, S. E., & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22(6), 1482–1493. doi.org/10.1037/0278-7393.22.6.1482
- Cavanaugh, R., & Haley, K. L. (2020). Subjective communication difficulties in very mild aphasia. *American Journal of Speech-Language Pathology*, 29(1S), 437–448. doi.org/10.1044/2019_ajslp-cac48-18-0222
- Fromm, D., Forbes, M., Holland, A., Dalton, S. G., Richardson, J., & MacWhinney, B. (2017). Discourse characteristics in aphasia beyond the western aphasia battery cutoff. *American Journal of Speech-Language Pathology*, 26(3), 762–768. doi.org/10.1044/2016_ajslp-16-0071
- Garrod, S., & Pickering, M. J. (2004). Why is conversation so easy? Trends in Cognitive Sciences, 8(1), 8–11. doi.org/10.1016/j.tics.2003.10.016
- Graham, D. (2006). Beyond the simple sentence level: A case study of a client with high level aphasia. In S. Byng, J. Duchan, & C. Pound (Eds.), *Aphasia therapy file: Volume two*. Hove: Psychology Press
- Kertesz, A. (2006). Western Aphasia Battery-Revised (WAB-R). APA PsychTests.
- Martin, N., Minkina, I., Kohen, F. P., & Kalinyak-Fliszar, M. (2018). Assessment of linguistic and verbal short-term memory components of language abilities in aphasia. *Journal of Neurolinguistics*, 48, 199–225.
- Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin*, 134(3), 427–459. doi.org/10.1037/0033-2909.134.3.427
- Pulvermüller, F., Neininger, B., Elbert, T., Mohr, B., Rockstroh, B., Koebbel, P., & Taub, E. (2001). Constraint-induced therapy of chronic aphasia after stroke. *Stroke: A Journal of Cerebral Circulation*, 32(7), 1621–1626. doi.org/10.1161/01.STR.32.7.1621

Silkes, J., Zimmerman, R. M., Greenspan, W., Reinert, L., Kendall, D., & Martin, N. (2021). Identifying verbal short-term memory and working memory impairments in individuals with latent aphasia. *American Journal of Speech-Language Pathology*, 30, 391-406. doi.org/10.1044/2020_AJSLP-19-00105

Acknowledgments

Research reported in this study was supported by the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health under award number NIDCD R 21DC021833. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Table 1. Scores on Pre- and Post-Measures for Two Participants

Assessment	Baseline	Immediate Post-treatment
Participant 1		
WAB-R AQ ¹ =90.8		
TALSA ² Sentence Repetition		
Content words: % correct in serial order (n=210)	0.67	0.66
Average words per trial (out of 7)	4.67	4.63
TALSA Rhyming Triplets (% Correct)	0.93	1
TALSA Synonymy Triplets (% Correct)	0.88	0.93
CCRSA ³	28 out of 40	31 out of 40
SAQOL ⁴	3.31 out of 5	3.69 out of 5
Participant 2		
WAB-R AQ ¹ =92.6		
TALSA ² Sentence Repetition		
Content words: % correct in serial order (n=196)	0.76	0.81
Average words per trial (out of 7)	5.29	5.64
TALSA Rhyming Triplets (% Correct)	0.83	0.97
TALSA Synonymy Triplets (% Correct)	0.68	0.73
CCRSA ³	32 out of 40	37 out of 40
SAQOL ⁴	3.08 out of 5	3.46 out of 5

¹Western Aphasia Battery-Revised, ²Temple Assessment of Language and Short-term Memory in Aphasia, ³CRSA=Communication Confidence Rating Scale for Aphasia,

⁴SAQOL=Stroke and Aphasia Quality of Life Scale.

Real-time processing of semantic constraint during silent reading: Evidence from eye tracking

Michael Scimeca^{1*}, Maria Varkanitsa¹, and Swathi Kiran¹

¹ Department of Speech, Language & Hearing Sciences, Boston University, Boston, MA, USA

*corresponding author, mscimeca@bu.edu

Introduction

Reading comprehension is often impaired in persons with aphasia (PWA), but the mechanisms underlying these deficits remain difficult to characterize. Eye tracking work has shown that PWA—relative to neurotypical controls—spend more time (re)reading sentences that have high semantic integration demands (Huck et al., 2019). In fact, PWA may adopt a two-tiered reading strategy, focusing on lexical retrieval during first-pass reading and lexical integration on successive passes (DeDe, 2017; DeDe & Kelleher, 2021) to compensate for increased syntactic integration demands—a view compatible with the Lexical Deficit Integration Hypothesis (Thompson & Choy, 2009). However, it remains unclear whether this two-tiered strategy extends to sentences with increased *semantic*, rather than syntactic, integration demands. To address this question, we examined how English-speaking individuals with mild aphasia read sentences with varying semantic constraint. Under the two-tiered account, high-constraint sentences—in which prior context biases the appearance of a target word (i)—should be comprehended faster and more accurately than low-constraint sentences, which are more weakly biasing overall (ii).

(i) *Before the performance the singer tuned the antique **piano** on the stage*

(ii) *In the morning the janitor placed the shiny **violin** on the stage*

Methods

Participants included three PWA (P01-P03; see Table 1) and one neurological control (C01). All participants read 88 trials split evenly between high- and low-constraint conditions while an Eyelink II eye tracker monitored their gaze. Each trial was self-paced and consisted of a 12-word, simple active sentence with an embedded target word and a yes/no comprehension question. For each sentence-question pair, we extracted sentence reading time, question reading time, and question accuracy. We also extracted fixation metrics including first fixation duration (FFD; first-pass reading) and re-reading duration (RRD; successive-pass reading) for the target word in bold in (i) and (ii).

Results

Relative to C01, all PWA exhibited increased sentence and question reading times (Figure 1A/B), along with longer first fixation durations (FFD) and rereading durations (RRD) at the target word (Figure 1D), reflecting increased cognitive effort during reading.

Among the PWA, two preliminary patterns emerged. First, low-constraint sentences consistently elicited longer RRD, suggesting that lexical integration was delayed when contextual support was weak. For at least P01 and P02, this was accompanied by slightly lower comprehension accuracy and longer question reading times for low- vs. high-constraint sentences, which suggests that the increased integration demands carried over into question response behaviors.

Second, high-constraint sentences were associated with longer FFD and total sentence reading times, suggesting that strong context–word matches may have prompted early but demanding integration attempts. Rather than easing processing, highly predictive contexts may have increased cognitive load by triggering immediate integration—which could be especially challenging for PWA with impaired semantic unification mechanisms.

Conclusions

These preliminary data support the notion that PWA delay integration especially when semantic comprehension demands are high (i.e., low-constraint). By contrast, when demands are low, PWA may attempt integration early, perhaps inadvertently increasing cognitive load. Our ongoing data collection with robust statistical analyses will be necessary to continue examining these patterns.

References

- DeDe, G. (2017). Effects of lexical variables on silent reading comprehension in individuals With aphasia: Evidence from eye tracking. *Journal of Speech, Language, and Hearing Research*, 60(9), 2589–2602.
https://doi.org/10.1044/2017_JSLHR-L-16-0045
- DeDe, G., & Kelleher, D. (2021). Effects of animacy and sentence type on silent reading comprehension in aphasia: An eye-tracking study. *Journal of Neurolinguistics*, 57, 100950. <https://doi.org/10.1016/j.jneuroling.2020.100950>
- Huck, A., Thompson, R. L., Cruice, M., & Marshall, J. (2017). Effects of word frequency and contextual predictability on sentence reading in aphasia: An eye movement analysis. *Aphasiology*, 31(11), 1307–1332.
<https://doi.org/10.1080/02687038.2017.1278741>
- Thompson, C. K., & Choy, J. J. (2009). Pronominal resolution and gap filling in aphasia: Evidence from eye movements. *Journal of Psycholinguistic Research*, 38(3), 255.
<https://doi.org/10.1007/s10936-009-9105-7>

Acknowledgments

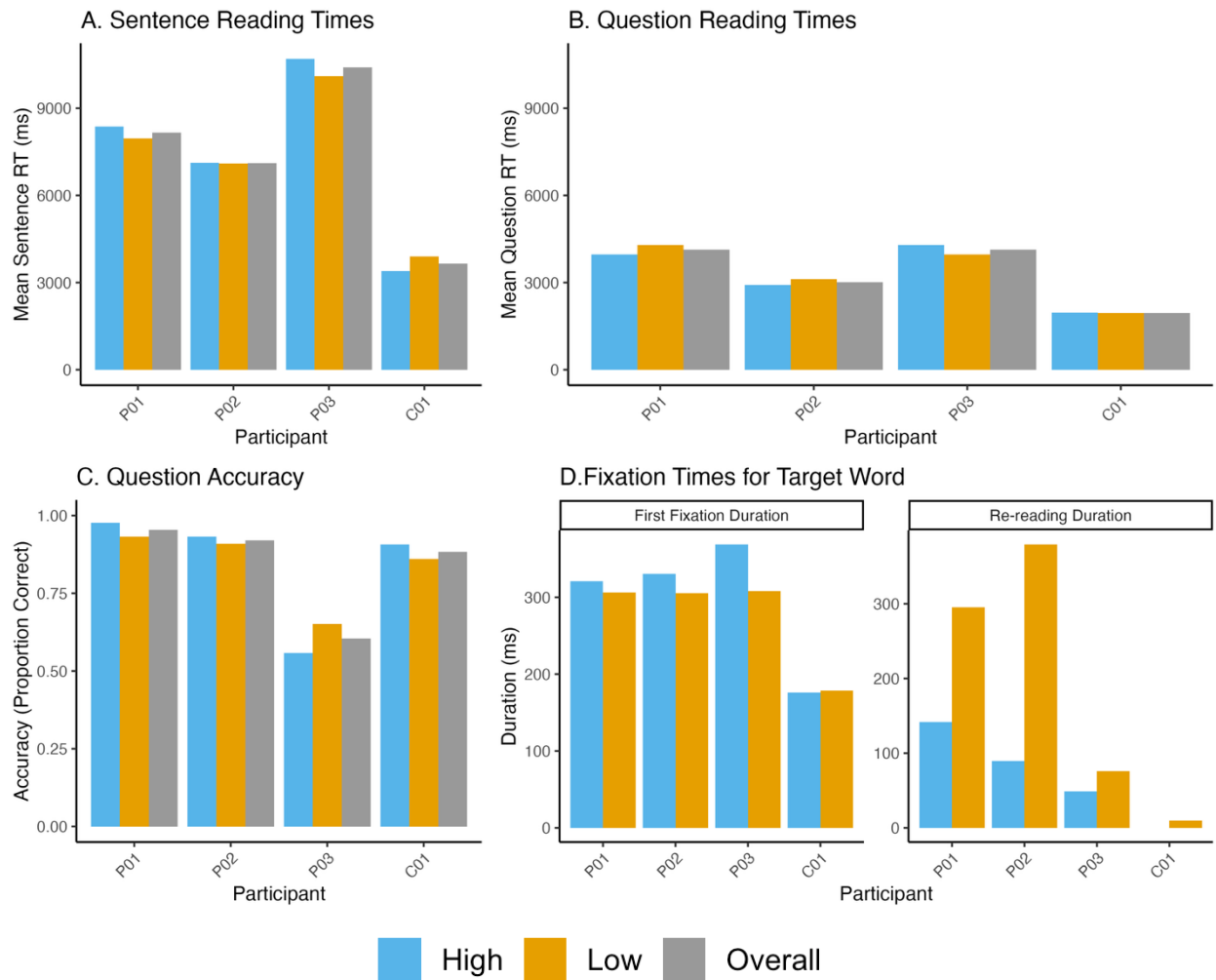
This work was graciously funded by NIH/NIDCD F31 DC021628 awarded to Michael Scimeca. We would also like to thank our participants and their caregivers who contributed to this study.

Table 1. Clinical Characteristics for PWA

Participant	Sex	Age	MPO	Edu	WAB AQ	WAB RS
P01	F	62	180	18	96.4	100
P02	F	70	89	22	97.7	96
P03	M	73	60	18	92.1	94

Note. *MPO* = Months Post-onset; *Edu* = Education (yrs); *WAB AQ* = Aphasia Severity /100 where higher scores indicate milder aphasia; *WAB RS* = WAB Reading Score /100 where higher scores indicate milder reading impairment

Figure 1. Reading Times and Eye Tracking Outcome Measures



Investigating the contribution of phonological short-term memory to sentence comprehension in post-stroke aphasia

Priyanka P. Shah-Basak^{1*}, Sara B. Pillay¹, Andrew Anderson¹, Jeffrey R. Binder¹

¹Department of Neurology, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

*corresponding author, prishah@mcw.edu

Introduction

Sentence comprehension relies on both linguistic and cognitive processes, including retrieval, short-term maintenance and integration of speech information (Horne et al., 2022). While there is an ongoing debate (Gvion & Friedmann, 2012), several prior studies (Gilardone et al., 2023; Horne et al., 2022; Papagno & Cecchetto, 2019; Rogalsky et al., 2008; Silveri & Cappa, 2003; Varkanitsa & Caplan, 2018) have shown a link between spoken sentence comprehension and phonological short-term memory (phonSTM), i.e. the ability to temporarily hold speech sounds “in mind”. Comprehension of complex (e.g., object-relative clause) sentences appears to depend more heavily on phonSTM than simpler forms (subject-relative) (Horne et al., 2022; Rogalsky et al., 2008). In this study, we replicated the association between phonSTM and complex sentence comprehension (SentComp) in 52 stroke survivors with aphasia (SWA), after controlling for single word comprehension (WordComp), both in terms of accuracy and processing speed. Slowed word processing may hinder the transmission (Martin & Dell, 2019) and temporal integration of speech, resulting in poorer comprehension. We also controlled for phonological retrieval, repetition abilities, and stroke lesion volume (as a proxy for aphasia severity).

Methods

Data were extracted retrospectively from the MCW Aphasia Databank. Complete datasets across all relevant measures were available for 56 individuals. For the final analysis, 52 SWA with $\geq 90\%$ accuracy on an auditory picture-to-word matching task, assessing WordComp, were included. PhonSTM span was computed from a delayed match-to-sample task using spoken trains of 1-5 consonant-vowel syllables with a 5-second delay (Pillay & Binder, n.d.). Sentence Comprehension was assessed using the Alberta Language Function Assessment Battery subtest (Westbury, 2007), where SWA decided whether a spoken (SentComp_{aud}) or a written (SentComp_{wrt}) sentence correctly described a short animated film. The syntactic structure of sentences for more complex forms including passive, object-relative clause and particle types were included in the analyses. Accuracy on nonword repetition (RepeatNon) and nonword rhyme matching (RhymeNon) and reaction times from the WordComp task (WordComp_{rt}) were also included. T1-weighted and T2 FLAIR images were used for lesion mapping using semi-automated procedures (Zhang et al., 2001), which were manually edited by an experienced stroke neurologist (Binder) to obtain lesion volumes (LesionVol). Statistical analyses included multiple linear regression and permutation testing to examine whether phonSTM contributes to spoken or written SentComp. The regression model setup was: $\text{SentComp}_{\text{aud}}$ (or $\text{SentComp}_{\text{wrt}}$) $\sim$ $\text{WordComp}_{\text{rt}} + \text{RepeatNon} + \text{RhymeNon} + \text{phonSTM}_{\text{span}} + \text{LesionVol}$

Results

Two regression models, one with (**Table 1**) and one without phonSTM span, were compared, with either SentComp_{aud} or SentComp_{wrt} as the dependent variable. Inclusion of phonSTM span improved model fit, increasing R^2 for SentComp_{aud} by 4.5% (**Figure 1**) and only by 1.7% for SentComp_{wrt}. A permutation test, shuffling phonSTM span labels (5000 iterations), confirmed that improvement for SentComp_{aud} ($p=0.038$) was unlikely due to chance, whereas the effect on SentComp_{wrt} ($p=0.251$) was non-significant. Slower WordComp speed predicted worse SentComp_{aud} ($p=0.008$).

Conclusions

Our results suggest that phonSTM uniquely contributes to spoken sentence comprehension beyond other phonological abilities. The speed of single word comprehension is a strong predictor of spoken sentence comprehension.

References

- Gilardone, G., Viganò, M., Costantini, G., Monti, A., Corbo, M., Cecchetto, C., & Papagno, C. (2023). The role of verbal short-term memory in complex sentence comprehension: An observational study on aphasia. *International Journal of Language & Communication Disorders*, 58(4), 1182–1190. <https://doi.org/10.1111/1460-6984.12851>
- Gvion, A., & Friedmann, N. (2012). Does phonological working memory impairment affect sentence comprehension? A study of conduction aphasia. *Aphasiology*, 26(3–4), 494–535. <https://doi.org/10.1080/02687038.2011.647893>
- Horne, A., Zahn, R., Najera, O. I., & Martin, R. C. (2022). Semantic Working Memory Predicts Sentence Comprehension Performance: A Case Series Approach. *Frontiers in Psychology*, 13, 887586. <https://doi.org/10.3389/fpsyg.2022.887586>
- Martin, N., & Dell, G. S. (2019). Maintenance Versus Transmission Deficits: The Effect of Delay on Naming Performance in Aphasia. *Frontiers in Human Neuroscience*, 13. <https://doi.org/10.3389/fnhum.2019.00406>
- Papagno, C., & Cecchetto, C. (2019). Is STM involved in sentence comprehension? *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*, 112, 80–90. <https://doi.org/10.1016/j.cortex.2018.08.028>
- Pillay, S. B., & Binder, J. R. (n.d.). *Language Imaging Lab (LIL) Aphasia Battery*. <https://www.neuromcwedu/aphasiabattery/indexhtml>
- Rogalsky, C., Matchin, W., & Hickok, G. (2008). Broca's area, sentence comprehension, and working memory: An fMRI study. *Frontiers in Human Neuroscience*, 2. <https://www.frontiersin.org/articles/10.3389/neuro.09.014.2008>
- Silveri, M., & Cappa, A. (2003). Segregation of the Neural Correlates of Language and Phonological Short-Term Memory. *Cortex*, 39(4–5), 913–925. [https://doi.org/10.1016/S0010-9452\(08\)70870-0](https://doi.org/10.1016/S0010-9452(08)70870-0)
- Varkanitsa, M., & Caplan, D. (2018). On the association between memory capacity and sentence comprehension: Insights from a systematic review and meta-analysis of the aphasia literature. *Journal of Neurolinguistics*, 48, 4–25. <https://doi.org/10.1016/j.jneuroling.2018.03.003>
- Westbury, C. (2007). *ALFAB: The Alberta Language Function Assessment Battery*. <http://www.psych.ualberta.ca/~westburylab/downloads/alfab.download.html>

Zhang, Y., Brady, M., & Smith, S. (2001). Segmentation of brain MR images through a hidden Markov random field model and the expectation-maximization algorithm. *IEEE Transactions on Medical Imaging*, 20(1), 45–57. <https://doi.org/10.1109/42.906424>

Figure 1. Model fit improves with the inclusion of phonSTM span (red vertical line) by 4.5% for spoken but only by 1.7% for written sentence comprehension. Blue bars represent the null distribution obtained from permutation testing.

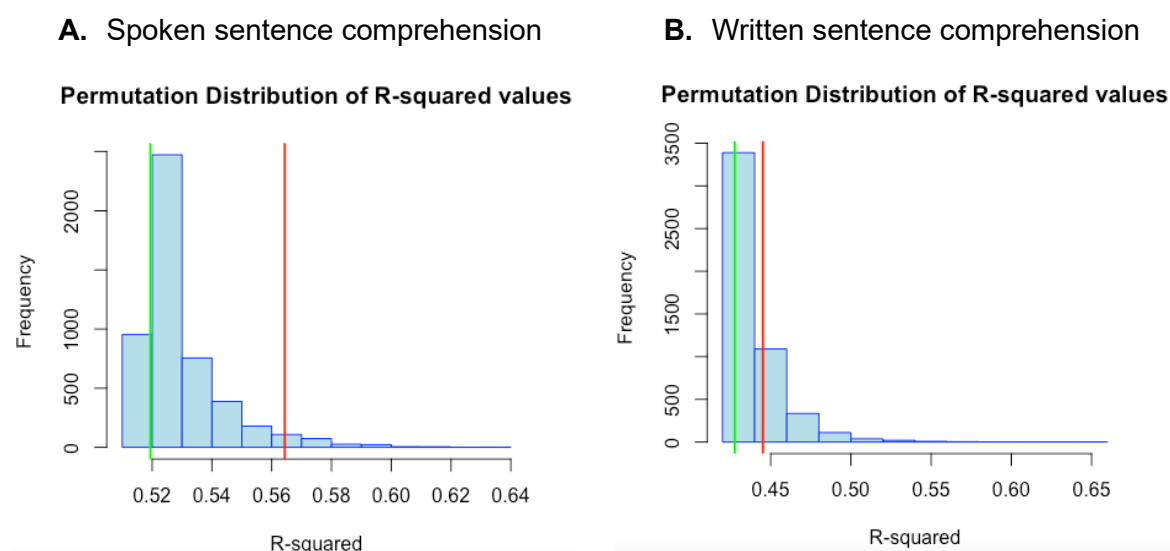


Table 1. Linear regression model outputs

	Estimate	SE	t	p
Spoken sentence comprehension				
SentComp _{aud} ~ WordComp _{rt} + RepeatNon + RhymeNon + phonSTM _{span} + LesionVol				
WordComp _{rt}	-0.005	0.002	-2.79	0.008
RepeatNon	0.102	0.062	1.66	0.104
RhymeNon	0.092	0.093	0.99	0.326
phonSTM _{span}	0.152	0.070	2.16	0.036
LesionVol	-0.054	0.042	-1.27	0.210
Written sentence comprehension				
SentComp _{wrt} ~ WordComp _{rt} + RepeatNon + RhymeNon + phonSTM _{span} + LesionVol				
WordComp _{rt}	-0.001	0.002	-0.34	0.737
RepeatNon	0.067	0.082	0.80	0.425
RhymeNon	0.170	0.124	1.37	0.178
phonSTM _{span}	0.112	0.094	1.19	0.240
LesionVol	-0.139	0.056	-2.46	0.018

Abbreviations: SentComp_{aud} = auditory or spoken sentence comprehension; SentComp_{wrt} = written or reading comprehension; WordComp_{rt} = reaction time on single word comprehension task; RepeatNon = nonword repetition accuracy; RhymeNon = nonword rhyme matching accuracy; phonSTM_{span} = span from the phonological short-term memory task; LesionVol = Lesion volume

Refining a Culturally Adapted Naming Test: Item Reduction and Psycholinguistic Profiling of the Korean BNT for Aphasia Severity Prediction

Junyoung Shin¹, Sejin Oh¹, Sujin Choi¹, Yu Mi Hwang²,
Sung-Bom Pyun^{2,3,4}, Jee Eun Sung^{1*}

¹Department of Communication Disorders, Ewha Womans University, Seoul, Republic of Korea

²Brain Convergence Research Center, Korea University College of Medicine, Seoul, Republic of Korea

³Department of Biomedical Sciences, Korea University College of Medicine, Seoul, Republic of Korea

⁴Department of Physical Medicine and Rehabilitation, Korea University Anam Hospital, Seoul, Republic of Korea

*corresponding author, jeesung@ewha.ac.kr, rmpyun@korea.ac.kr

Introduction

The Boston Naming Test (BNT; Kaplan et al., 1983) is one of the most widely used standardized tools for assessing naming abilities, particularly in individuals with aphasia and other neurogenic language disorders. The Korean version of the BNT (K-BNT; Kim & Na, 1997) has been culturally adapted to reflect linguistic and cultural appropriateness, with only a subset of items overlapping with the original English version. However, such adaptation may lead to variability in the psycholinguistic and clinical properties of individual items. The present study aimed to reduce the number of K-BNT items while preserving their ability to predict overall aphasia severity, measured by the Aphasia Quotient (AQ) from the Paradise Korean-Western Aphasia Battery-Revised (PK-WAB-R; Kim & Na, 2012). Using data-driven approaches, including Lasso regression and Item Response Theory (IRT), we identified a reduced set of informative items and examined their psychometric characteristics. The goal is to enhance the clinical utility and efficiency of the K-BNT as a culturally valid naming assessment tool.

Methods

Participants

A total of 182 native Korean-speaking persons with aphasia (PWA), recruited from a STroke Outcome Prediction database (STOP DB; Department of physical treatment and rehabilitation, Korea University Anam hospital, Seoul, Republic of Korea), participated in the study. All participants had completed both the K-BNT (Kim & Na, 1997) and the PK-WAB-R (Kim & Na, 2012). Participants had a mean age of 63.91 years (SD=14.73), a post-onset duration of 7.89 months (SD =19.80), and an AQ of 29.11(SD=17.60).

Results

Item Reduction via LASSO Regression

A LASSO regression analysis was conducted to determine which K-BNT items best predicted aphasia severity, as measured by the AQ score from the PK-WAB-R. Based on ten-fold cross-validation, a reduced set of 28 items was identified as the optimal predictor set ($R^2=0.746$, RMSE=11.38, $\lambda=0.619$).

Comparison of Reduced vs. Non-selected Items

The reduced items ($M=0.58$, $SD=0.20$) showed significantly higher naming accuracy than the non-selected items ($M=0.37$, $SD=0.54$, $p=.004$). Similarly, the reduced items also had significantly higher lexical log-frequency ($M=.083$, $SD=0.20$) compared to the non-selected items ($M=0.40$, $SD=0.18$, $p<.001$).

Cluster Analysis and IRT-based Comparison of Reduced Items

A hierarchical cluster analysis based on the reduced item set identified three distinct clusters. To examine how performance on the reduced item set and within each cluster was related to the K-BNT total score and AQ, Pearson correlation analyses were conducted. Among all subsets, performance on the reduced items ($r=.982$) and Cluster 3 ($r=.961$) demonstrated the strongest positive correlations with the K-BNT total score. Similarly, performance on the reduced items ($r=.834$) and Cluster 3 ($r=.813$) also exhibited the highest correlations with AQ. Finally, comparisons of item discrimination and difficulty parameters derived from IRT revealed no significant differences between the reduced item set and Cluster 3.

Conclusions

The item reduction analysis of the K-BNT revealed two reliable subsets that accurately reflect overall naming performance and aphasia severity. The two subsets differed in length, with one comprising 28 items and the other 14 items. Despite the difference in the number of items, both subsets demonstrated comparable validity, as indicated by similar predictive coefficients and no significant differences in item difficulty or discrimination parameters. These findings support the clinical utility of the shortened K-BNT versions, highlighting their potential to enhance assessment efficiency without compromising diagnostic accuracy.

References

- Kaplan, E., Goodglass, H., & Weintraub, S. (1983). Boston Naming Test. *Philadelphia, PA: Lea & Febiger*.
- Kim, H. H., & Na, D. L. (1997). Korean version-Boston naming test. *Seoul: Hakjisa*.
- Kim, H., & Na, D. L. (2012). Paradise Korean Version of the Western Aphasia Battery Revised (PK-WAB-R). *Seoul: Paradise Welfare Foundation*.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Ministry of Science and ICT (MSIT) (No. 2022R1A2C2005062, RS-2024-00461617), by the National Research Council of Science & Technology (NST) grant funded by MSIT (No. CAP21054-000), by the NRF grant funded by the Ministry of Education (No. NRF-2022R111A4063209), and by the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare (No. HI23C0156).

Figure 1. Scatter plots showing the correlation between Aphasia Quotient (AQ) and K-BNT scores based on all 60 items, a reduced 28 items, and 14 items in a Cluster 3. Each plot includes a linear regression line with a 95% confidence interval.

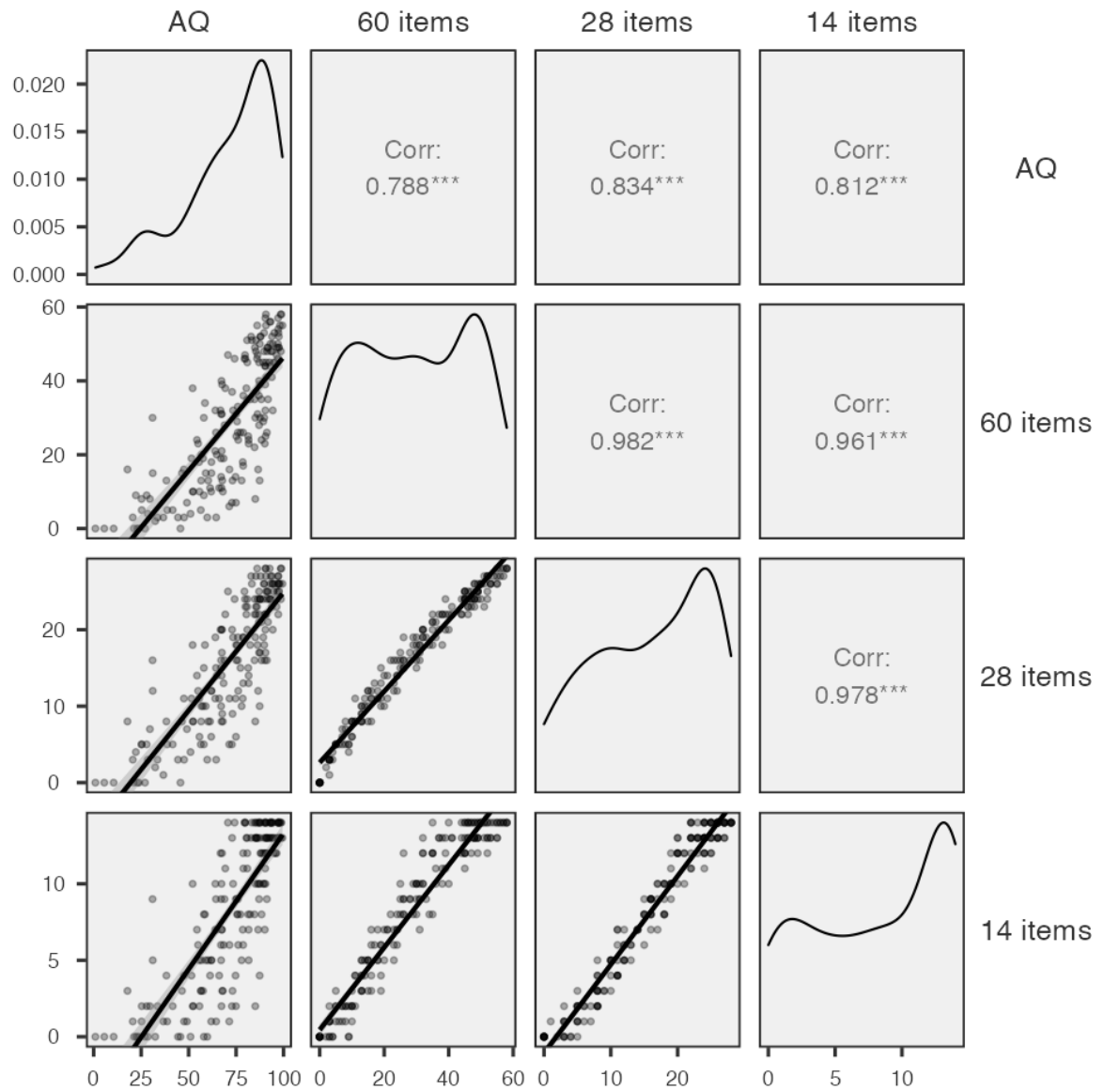


Table 1. Pearson Correlations and ANOVA Comparisons of Item Subsets in the K-BNT

A. Pearson correlation coefficient between item subsets						
	K-BNT items (n=60)	Reduce d items (n=28)	C1 items (n=7)	C2 items (n=7)	C3 items (n=14)	
K-BNT score	1	r=.982**	r=.868**	r=.757**	r=.961**	-
AQ	r=.788**	r=.834**	r=.650**	r=.753**	r=.813**	-
B. Comparisons of item characteristics between item subsets						
	K-BNT items (n=60)	Reduce d items (n=28)	C1 items (n=7)	C2 items (n=7)	C3 items (n=14)	ANOVA result
Lexical log- frequency	M=0.58	M=0.83	M=0.50	M=1.45	M=0.68	<u>Sig.(p=.013)</u>
	SD=0.64	SD=0.68	SD=0.44	SD=0.83	SD=0.51	-C2 > K-BNT items
Number of syllables	M=2.63	M=2.57	M=3.00	M=2.42	M=2.42	<u>Not sig.(p=.628)</u>
	SD=0.80	SD=0.87	SD=1.41	SD=0.78	SD=0.51	
Item discrimination(a)						<u>Sig.(p<.001)</u>
	M=2.65	M=-0.51	M=2.46	M=2.46	M=-0.56	K-BNT items > C3 = Reduced items
	SD=0.69	SD=1.78	SD=0.46	SD=0.58	SD=0.84	Reduced items > C1 = C2
						C3 > C1 = C2
Item difficulty(b)						<u>Sig.(p<.001)</u>
	M=0.10	M=-0.23	M=0.70	M=-1.13	M=-0.25	C2 < K-BNT items=Reduced item
	SD=0.77	SD=0.74	SD=0.48	SD=0.23	SD=0.32	C1 > C2 = C3

Note. C=Cluster; M=Mean, SD=Standard Deviation; Sig=Significant. **p<.001

Comparison of picture-naming errors produced by individuals with post-stroke aphasia (PSA) and individuals with variants of primary progressive aphasia (PPA)

Erie H. Shivers^{1*}, Marissa Russell-Meill¹, Shalom Henderson¹, Lucía Fernández-Romero², Divya Sivakumar¹, Maria Valiente¹, Jordi A. Matias-Guiu², Swathi Kiran¹

¹ Center for Brain Recovery, Boston University, Boston, (Massachusetts), United States of America

² Department of Neurology, San Carlos Institute for Health Research, Madrid, (Madrid), Spain

***Corresponding author, erinhana@bu.edu**

Introduction

Numerous studies have analyzed the naming error profiles in both post-stroke aphasia (PSA) and the variants of primary progressive aphasia (PPA), with literature suggesting that picture-naming tasks are valuable tools in assessing lexical retrieval, predicting language recovery in PSA, and decline in PPA (Herbert et al., 2008, Meier et al., 2020, Stockbridge et al., 2023). Although semantic errors are reported to be prevalent in both PSA and PPA (Bruffaerts et al., 2020, McKinnon et al., 2018, Meyer et al., 2024), few studies have directly compared naming errors produced in stroke and dementia (PPA) using detailed scoring criteria for semantic errors (e.g., associative errors, coordinate errors, and superordinate errors). Our study examines the naming error profiles of individuals with PSA compared to those with PPA by analyzing the distribution of naming error types produced on picture-naming tasks using detailed scoring criteria. We hypothesized that individuals with PSA would demonstrate a wider range of error types (McKinnon et al., 2018, Meier et al., 2024), whereas individuals with PPA would produce more errors based on their primary deficit (Montembeault et al., 2018).

Methods

Seventy-eight individuals diagnosed with PPA (Gorno-Tempini et al., 2011) (logopenic variant (lv) n=30, non-fluent variant (nfv) n=28, semantic variant (sv) n=20) completed a twenty-item picture naming task administered at the San Carlos Institute for Health Research. Forty-eight individuals with PSA completed a forty-five-item picture naming task conducted at the Center for Brain Recovery. Both the twenty- and forty-five-item naming tasks were administered in Spanish and contained images of objects that spanned a range of lexical frequencies. Responses were scored for correctness and error types for all groups were coded as associative, circumlocution, coordinate, correct, mixed, motor speech, neologism, no response, other, perseveration, phonological, superordinate, or unrelated based on modified scoring criteria established by Kiran et al. (2014).

Results

Participant groups were matched in education and sex, but PSA participants were significantly younger ($p<.001$) (Table 1). Results of Pearson's chi-squared test showed a significant difference in the distribution of response types between the four participant groups ($p<.001$). Standard residuals showed that compared to the null

hypothesis which assumed error type distribution was consistent across groups, PSA patients produced more of a wide range of error types and made less correct responses; lvPPA patients produced more correct responses and phonological errors; nfvPPA patients made more motor speech errors and more correct responses; and svPPA patients produced more superordinate errors and no responses (Figure 1).

Conclusions

While anomia is a shared symptom across PPA and PSA, the distribution of error types between groups differed significantly. PSA patients produced fewer correct responses and a wider range of error types, reflecting greater naming impairment in this group. In contrast, the PPA variants made errors characteristic of their core deficit (e.g. phonological errors in lvPPA resulting from deficits in phonological retrieval and working memory, superordinate errors in svPPA resulting from degraded semantic representations, etc.) These findings highlight the diagnostic value of naming error analysis in differentiating aphasia syndromes by etiology and may inform both clinical assessments and intervention.

References

- Bruffaerts, R., Schaefferbeke, J., De Weer, A., Nelissen, N., Dries, E., Van Bouwel, K., Sieben, A., Bergmans, B., Swinnen, C., Pijnenburg, Y., Sunaert, S., Vandenbulcke, M., & Vandenberghe, R. (2020). Multivariate analysis reveals anatomical correlates of naming errors in primary progressive aphasia. *Neurobiology of Aging*, Volume(88), 71-82.
- Gorno-Tempini, M., Hillis, A., Weintraub, S., Kertesz, A., Mendez, M., Cappa, S., Ogar, J., Rohrer, J., Black, S., Boeve, B., Manes, F., Dronkers, N., Vandenberghe, R., Rascovsky, K., Patterson, K., Miller, B., Knopman, D., Hodges, J., Mesulam, M., & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, Volume(76).
- Herbert, R., Hickin, J., Howard, D., Osborne, F., & Best, W. (2008). Do picture-naming tests provide a valid assessment of lexical retrieval in conversation in aphasia. *Aphasiology*, Volume(22), 184-203.
- Kiran, S., Balachandran, I., & Lucas, J. (2014). The nature of lexical-semantic access in bilingual aphasia. *Behavioral Neurology*, Volume(2014), 18 pages.
- McKinnon, E., Fridriksson, J., Basilakos, A., Hickok, G., Hillis, A., Spampinato, V., Gleichgerricht, E., Rorden, C., Jensen, J., Helpert, J., & Bonilha, L. (2018). Types of naming errors in chronic post-stroke aphasia by dual stream axonal loss. *Scientific Reports*, Volume(8).
- Meier, E., Sheppard, S., Goldberg, E., Head, C., Ubellacker, D., Walker, A., & Hillis, A. (2020). Naming errors and dysfunctional tissue metrics predict language recovery after acute left hemisphere stroke. *Neuropsychologia*, Volume(148).
- Meyer, A., Snider, S., Tippet, D., Saloma, R., Faria, A., Turkeltaub, P., Hillis, A., & Friedman, R. (2024). The pattern of phonological, semantic, and circumlocution naming errors for nouns and verbs in primary progressive aphasia. *Aphasiology*, Volume(39), 514-538.
- Montembeault, M., Brambati, SM., Gorno-Tempini, ML., & Migliaccio, R. (2018). Clinical anatomical, and pathological features in the three variants of primary progressive aphasia: a review. *Frontiers in Neurology*, Volume(9).
- Stockbridge, M. D., Tippet, D. C., Breining, B. L., & Hillis, A. E. (2023). When words first fail: Predicting the emergence of primary progressive aphasia variants from

unclassifiable anomic performance in early disease. *Aphasiology*, 37(8), 1173-1185.

Acknowledgments

We sincerely thank the participants and their families for supporting this work.

Figure 1. Heat map of standard residuals for lvPPA (n=30), nfvPPA (n= 8), svPPA (n=20), and PSA (n=48) for each of the thirteen response types.

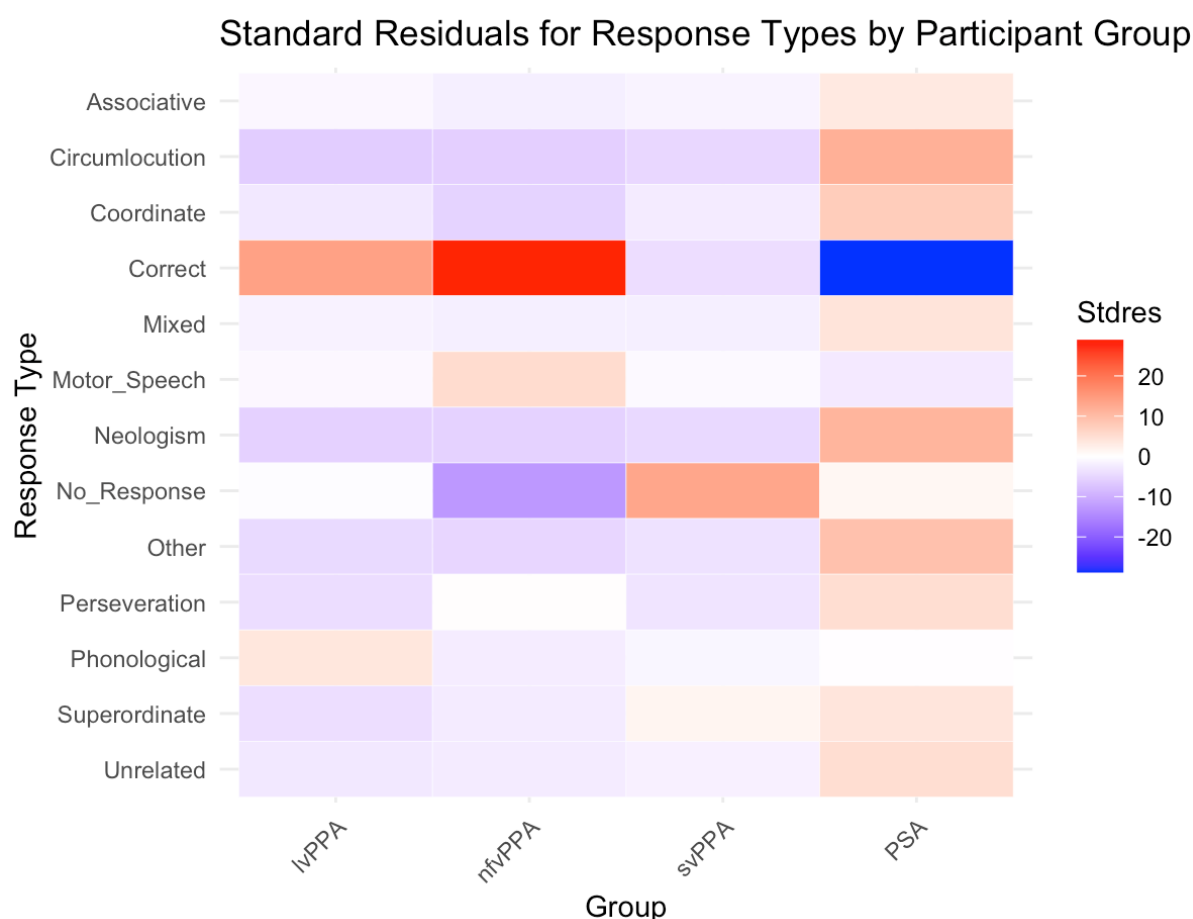


Table 1. Demographics of study cohort

	lvPPA n = 30	nfvPPA n = 28	svPPA n = 20	PSA n = 48	p-value
Age					2.54e-15
Mean (SD)	76.4 (6.9)	67.9 (6.7)	67.7 (8.1)	53.9 (15.9)	
Education					0.226
Mean (SD)	13.0 (5.4)	12.1 (5.2)	11.65 (6.3)	14.0 (3.4)	
Sex, n (%)					0.9936
Female	11 (36.6%)	11 (39.3%)	8 (40.0%)	19 (39.6%)	
Male	19 (63.3%)	17 (60.7%)	12 (60.0%)	29 (60.4%)	

To cue or not to cue? Preliminary findings from three anomia treatments

Tijana Simic^{1-3*}, Rudra Patel^{1,4}, Madeleine Coppolino¹, Aaron Vincent¹, Chaerin Jang¹, Erin Kim¹ & Nadia Faehndrich¹

¹ Department of Speech Language Pathology, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada

² Rehabilitation Sciences Institute, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada

³ KITE Toronto Rehab, University Health Network, Toronto, ON, Canada

⁴ Neurology, Department of Clinical Neurosciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada

***corresponding author, tina.simic@utoronto.ca**

Introduction

Improved naming after cueing has been widely documented (Hickin et al.,2002). Even a single cue can lead to correct naming of target words immediately and days later (Nardo et al.,2017; Best et al.,2002). The most common types of cueing in anomia therapy are semantic and phonological, which appear to yield comparable improvements in naming ability (e.g., see Wisenburn & Mahoney,2009). However, treatment studies have also shown that rote naming, even without feedback or cueing, can lead to naming improvements (Fillingham et al.,2005; Off et al.,2016). Thus, it remains unclear to what extent cueing enhances treatment efficacy relative to uncued naming practice. In the present study we compare the efficacy of semantic and phonological cueing to an analogous no cueing treatment for anomia.

Methods

Sixteen pre-morbidly right-handed, primarily English-speaking adults (mean age=66.8 years, SD=9.6), with chronic post-stroke aphasia (mean months post-onset=94.1, SD=48.9), after left-hemisphere stroke, were enrolled. Average aphasia severity based on the Western Aphasia Battery (Kertesz, 2006) Aphasia Quotient was 70.6 (SD=12.2). Stimuli named incorrectly on at least 2/3 baselines (322 stimuli each) were used to select treatment targets. Two lists of 30 words each were created per participant: one was targeted in treatment, the other was a within-participant untreated list, matched on various linguistic characteristics. Participants were randomly assigned to one of three cueing conditions targeting naming: phonological components analysis (PCA; e.g., Leonard et al.,2008), semantic feature analysis (SFA; e.g., Gravier et al.,2018), or uncued. The conditions were matched in terms of treatment structure (i.e., guided self-cueing using a chart), treatment schedule (i.e., four days/week for three weeks), number of sessions (i.e., 12), therapist feedback, and number of naming attempts per trial (i.e., 3). Primary outcome measures were: naming accuracy of treated and untreated words pre- and post-treatment and at 4- and 8-week follow-ups, and naming accuracy on an untrained naming task (i.e., the Philadelphia Naming Test (PNT; Roach et al.,1996)), pre- to post-treatment.

Results

Five participants each were randomized to the PCA and SFA conditions, and six to the uncued condition. The data show significant improvements in naming accuracy of the treated (compared to untreated) words from pre-treatment to post-treatment

($F_{1,13}=60.7$, $p<.001$), pre- to 4-week follow-up ($F_{1,13}=32.4$, $p<.001$) and pre- to 8-week follow-up ($F_{1,13}=28.1$, $p<.001$). No significant differences were found between treatment approaches: SFA, PCA and uncued conditions were equally efficacious. Our data also demonstrate generalization to an untrained naming task, with significant pre- to post-treatment improvements on the PNT ($t(15)=-2.7$, $p=.02$). No significant differences in generalization were found between SFA, PCA and uncued conditions.

Conclusions

Interim results suggest comparable improvements in treated-word naming accuracy and generalization across phonological, semantic and uncued conditions: all approaches induce significant improvements in naming accuracy. Data collection is ongoing to increase sample size, and analysis of speech errors is ongoing to determine whether cue type differentially targets semantic versus phonological levels of representation in the word retrieval system. This study provides novel insights regarding the relative benefits of cueing and rote naming practice in anomia therapy.

References

- Best, W., Herbert, R., Hickin, J., Osborne, F., & Howard, D. (2002). Phonological and orthographic facilitation of word-retrieval in aphasia: Immediate and delayed effects. *Aphasiology*, 16(1/2), 151-168.
- Fillingham, J. K., Sage, K., & Lambon Ralph, M. A. (2005). Further explorations and an overview errorless and errorful therapy for aphasic word-finding difficulties: The number of naming attempts during therapy affects outcome. *Aphasiology*, 19(7), 597-614.
- Gravier, M. L., Dickey, M. W., Hula, W. D., Evans, W. S., Owens, R. L., Winans-Mitrik, R. L., & Doyle, P. J. (2018). What matters in semantic feature analysis: Practice-related predictors of treatment response in aphasia. *American Journal of Speech-Language Pathology*, 27(1S), 438-453. doi:10.1044/2017_AJSLP-16
- Hickin, J., Best, W., Herbert, R., Howard, D., & Osborne, F. (2002). Phonological therapy for word-finding difficulties: A re-evaluation. *Aphasiology*, 16(10-11), 981-999. doi:10.1080/02687030244000509
- Kertesz, A. (2006). *Western Aphasia Battery-Revised*. Texas: Harcourt Assessments.
- Leonard, C., Rochon, E., & Laird, L. (2008). Treating naming impairments in aphasia: Findings from a phonological components analysis treatment. *Aphasiology*, 22(9), 923-947.
- Nardo, D., Holland, R., Leff, A. P., Price, C. J., & Crinion, J. T. (2017). Less is more: Neural mechanisms underlying anomia treatment in chronic aphasic patients. *Brain*, 140(11), 3039-3054. doi:10.1093/brain/awx234
- Off, C. A., Griffin, J. R., Spencer, K. A., & Rogers, M. A. (2016). The impact of dose on naming accuracy with persons with aphasia. *Aphasiology*, 30(9), 983-1011. doi:10.1080/02687038.2015.1100705
- Roach, A., Schwartz, M.F., Martin, N., Grewal, R.S., & Brecher, A. (1996). The Philadelphia Naming Test: Scoring and Rationale. *Clinical Aphasiology*, 24, 121-133.
- Wisenburn, B. & Mahoney, K. (2009). A meta-analysis of word-finding treatments for aphasia. *Aphasiology*, 23(11), 1338-135.

Acknowledgments

Funding for this work was generously supported by the Canadian Institutes of Health Research via a Brain Canada Foundation Future Leaders in Canadian Brain Research operating grant to Dr. Tijana Simic (PI). The authors would like to sincerely thank the patients and their families for their participation, as well as the staff and volunteers at the March of Dimes Aphasia and Communication Disabilities Program, Halton-Peel Community Aphasia Programs, and the Aphasia Institute for their collaboration and assistance with participant recruitment. The authors wish to acknowledge the invaluable contributions of numerous research assistants: Ramsha Babar, Erica Eng, Kiruththika Pushpalingam, Kira Rosenbloom, Melissa Sgambelluri, and Katerina Simantirakis.

Shared Neural Bases for Word-Form Learning and Re-Learning

Sartaj Singh², Robert Wiley², Yuan Tao¹, Jennifer Shea¹ and Brenda Rapp^{1*}

¹Johns Hopkins University

²University of North Carolina Greensboro

*Corresponding author, brapp1@jhu.edu

Introduction

Little is understood about the neural mechanisms that support the “relearning” of word-forms following neural injury (e.g., stroke). One key question: To what extent does post-stroke word-form re-learning make use of the mechanisms of new word learning? To address this, we considered two studies: one involving new word-form learning in older adults, the other involving behavioral treatment for word forms in post-stroke dysgraphia. First, we identified brain regions where BOLD language responsiveness predicted new orthographic word-form learning in older adults. Second, we evaluated the extent to which BOLD language responsiveness in the same regions predicted word-form re-learning in post-stroke dysgraphia.

Methods

Study 1: New word-form learning

23 older adults (mean age = 67.1) were tasked with learning 36 novel words (spellings, pronunciations and meanings) in a fantasy story over ~6 weeks. Prior to the learning sessions, all participated in MRI, including a Language Localizer during which they heard 8 brief Stories (24 seconds each) and Reversed Speech (18 seconds each), and were told that comprehension questions would follow.

Study 2: Word-form re-learning in post-stroke dysgraphia

Participants were 20 individuals (mean age = 63 years, mean post-stroke = 81 months). They were administered dysgraphia word-form treatment over an average of 10 weeks. All participants were administered the Language Localizer Task (described above), prior to treatment onset.

Analyses and Results

Study 1: New word -form learning. (1) From a whole-brain analysis, 11 ROIs exhibiting BOLD Stories > Reversed Speech were identified ($p < 0.01$); (2) For each ROI plus bilateral hippocampi, we used LMED to evaluate if individual differences in novel word-form learning accuracy were predicted by BOLD differences in the language responsiveness (Stories > Reversed Speech) of each ROI, controlling for years of education. Significant effects were identified for 8 ROIs that included the following areas: L-IFG(tri), L-AG, R cerebellum, and bilateral STG, MTG and hippocampus (p 's < 0.05), as well as R-ATL, L-IFG(oper) ($p < 0.10$).

Study 2: Word-form re-learning. We examined all ROIs from Study 1 in which language responsiveness predicted new word learning to evaluate if individual differences in behavioral re-learning scores in dysgraphia treatment were predicted by differences in the BOLD language responsiveness of those brain regions, controlling for age, education, WAB AQ, lesion volume, pre-treatment accuracy, and word frequency and length. Significant effects were identified for L-IFG (tri), L-MTG, L- STG, L-AG, R-ATL, and bilateral hippocampus (p 's < 0.05).

Conclusions

We found that BOLD response in bilateral hippocampus and most of the same cortical language-responsive regions of cortex that predicted new word-form learning in neurologically healthy older adults, also predicted response to dysgraphia treatment in older stroke survivors. The finding that both subcortical (hippocampal) and cortical (language cortex) areas were associated with learning and also relearning is consistent with Complementary Learning Systems Theory (McClelland et al., 1995) that posits critical and complementary roles for these structures during learning. While interpretation is admittedly complex, the findings raise the clear possibility of there being at least some shared neural mechanisms for new word-form learning and response to word-form treatment in individuals acquired lexical deficits.

Acknowledgements

Therapeutic Cognitive Neuroscience Fund, Department of Neurology. Johns Hopkins Medical Institutions.

References

- McClelland, J.L., McNaughton, B.L., & O'Reilly, R.C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review*, 102(3), 419-457.

Reducing the Need for Cueing: The Impact of tDCS on Sentence Comprehension in Aphasia

Luke Sippel¹ and Ellyn A. Riley^{1*}

¹ Department of Communication Sciences and Disorders, Syracuse University,
Syracuse, NY, USA

*corresponding author, earil100@syr.edu

Introduction

Transcranial direct current stimulation (tDCS) has mixed results when paired with speech and language treatment, but often enhances aphasia treatment outcomes (e.g., Fridriksson et al., 2018). Many aphasia studies have investigated tDCS's effect on language task accuracy, but none have specifically examined its effects on treatment cueing. Although not involving aphasia, Pergolizzi and Chua (2017) found that healthy college-age students who received active tDCS were able to use cueing more effectively than those who received sham stimulation in a memory task. This study examined frequency and effectiveness of treatment cues during tDCS paired with behavioral sentence comprehension treatment in a double-blinded, randomized clinical trial.

Methods

Twenty-two participants with mild to moderate Aphasia, at least 6 months post-stroke, were randomly assigned to active or sham tDCS. In the active condition, 2 mA of current was administered for 20 minutes while the participant received 60 minutes of attention-focused language treatment (similar to Peach et al., 2019). The sham condition was identical except that current was ramped up to 2 mA for 30 seconds (to simulate the sensation of tDCS), then reduced to 0 mA. Electrode placement was identical across conditions (anode electrode on left dorsolateral prefrontal cortex, cathode electrode on right supraorbital region). Participants each received ten of these sessions, progressing through five sentence comprehension treatment tasks that increased in difficulty. In our treatment protocol, participants received cues from the clinician when their initial response was inaccurate. Cue types were predetermined for each treatment item, but only provided when needed, allowing us to assess their reliance on cues in treatment. Accuracy of initial and subsequent responses (after receiving the cue) were recorded. We compared the number of cues administered between conditions using nonparametric statistical methods.

Results

Participants who underwent active tDCS needed fewer treatment cues than those who received sham tDCS (see Figure 1). When separating cue frequency by treatment task type, cueing frequency was significantly lower for the active ($M = 2.90$ $SD = 2.46$) tDCS condition as compared to sham ($M = 3.62$ $SD = 2.72$) in one of the most difficult treatment tasks, but the difference was not significant for the others. This pattern was consistent across two of the three cue types. Although participants receiving active tDCS did not need as many cues as those in the sham condition, success of using cues did not differ across the treatment conditions.

Conclusions

Our findings suggest that active tDCS administered to prefrontal brain regions during sentence comprehension treatment may reduce the number of cues needed to successfully complete treatment tasks. This finding could have important clinical implications in personalizing therapy and provides evidence in stroke and Aphasia beyond what has been found in healthy controls (Pergolizzi and Chua, 2017). Therapy could become more efficient if fewer cues are needed for success, allowing participants to achieve more in each session. Results showing this effect in one of the most difficult tasks suggest potential for maximizing gains in treatment by progressing through therapy more quickly and perhaps advancing to harder tasks earlier than typical.

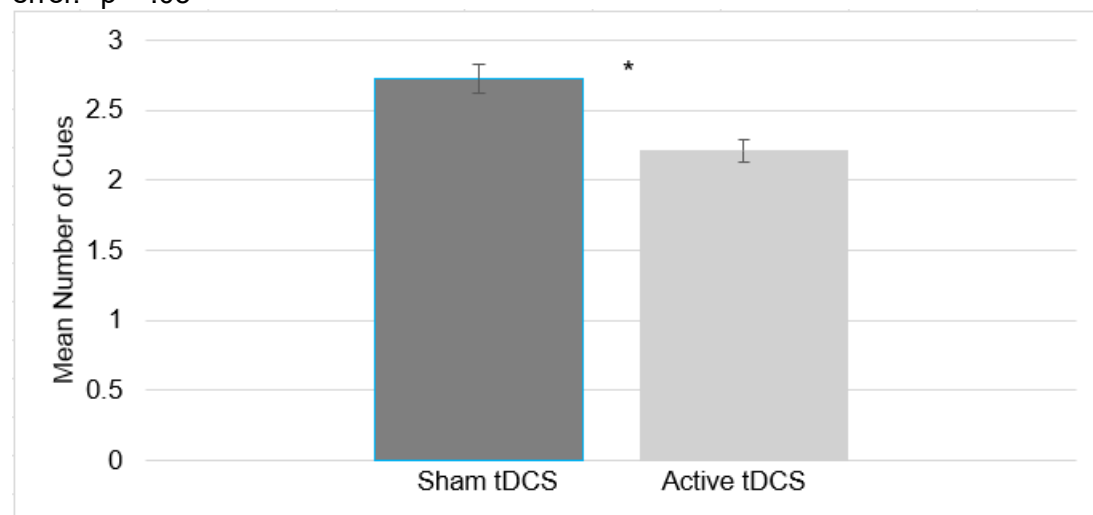
References

- Fridriksson, J., Rorden, C., Elm, J., Sen, S., George, M.S., & Bonilha, L. (2018). Transcranial direct current stimulation vs sham stimulation to treat aphasia after stroke: A randomized clinical trial. *JAMA Neurol.* 75(12):1470-1476.
- Peach, R. K., Beck, K. M., Gorman, M., & Fisher, C. (2019). Clinical outcomes following language-specific attention treatment versus direct attention training for aphasia: A comparative effectiveness study. *Journal of Speech, Language, and Hearing Research*, 62(8), 2785–2802.
- Pergolizzi, D., & Chua, E. F. (2017). Increased contextual cue utilization with tDCS over the prefrontal cortex during a recognition task. *Brain Research*, 1655, 1-9. <https://doi.org/10.1016/j.brainres.2016.11.008>

Acknowledgements

Funded by NIDCD R21DC017787 (PI: Riley).

Figure 1. Number of cues administered in each tDCS condition. Error bars show standard error. * $p < .05$



Intermittent Theta Burst Stimulation and Its Influence on Video Action Naming in Individuals With Post-Stroke Aphasia

Manon Spigarelli^{1*}, Hugo Massé-Alarie¹, and Maximiliano A. Wilson¹

¹ Rehabilitation, École des Sciences de la Réadaptation, Québec, (Qc), Canada and Centre interdisciplinaire de recherche en réadaptation et intégration sociale, Québec (Qc), Canada

*Manon Spigarelli, manon.spigarelli.1@ulaval.ca

Introduction

Intermittent theta burst stimulation (iTBS) is a promising brain stimulation technique for language rehabilitation in individuals with post-stroke aphasia. The effects of iTBS on object naming have been relatively well documented (for reviews, see Arheix-Parras et al., 2021; Kielar et al., 2022; Li et al., 2015; Williams et al., 2024). Conversely, little is known about its potential to enhance action naming. Aims: To explore the role of iTBS administered to the pars opercularis of the left inferior frontal gyrus on video action naming in people with chronic post-stroke aphasia.

Methods

Six individuals with chronic left-hemisphere stroke aphasia participated in the study. We used a video-based task to evaluate action naming, while a working memory task served as a control measure. The iTBS treatment took place once per day for two weeks. The stimulation protocol targeted the left pars opercularis using bursts at 50 Hz (200 seconds per session), calibrated at 80% of the active motor threshold.

Results

Video action naming significantly improved after the iTBS treatment for all participants (Figure 1). No significant changes were observed in working memory.

Conclusions

iTBS proved to be an effective approach to facilitate the recovery of action naming in chronic aphasia. These results highlight the role of the pars opercularis of the left inferior frontal gyrus in action naming.

References

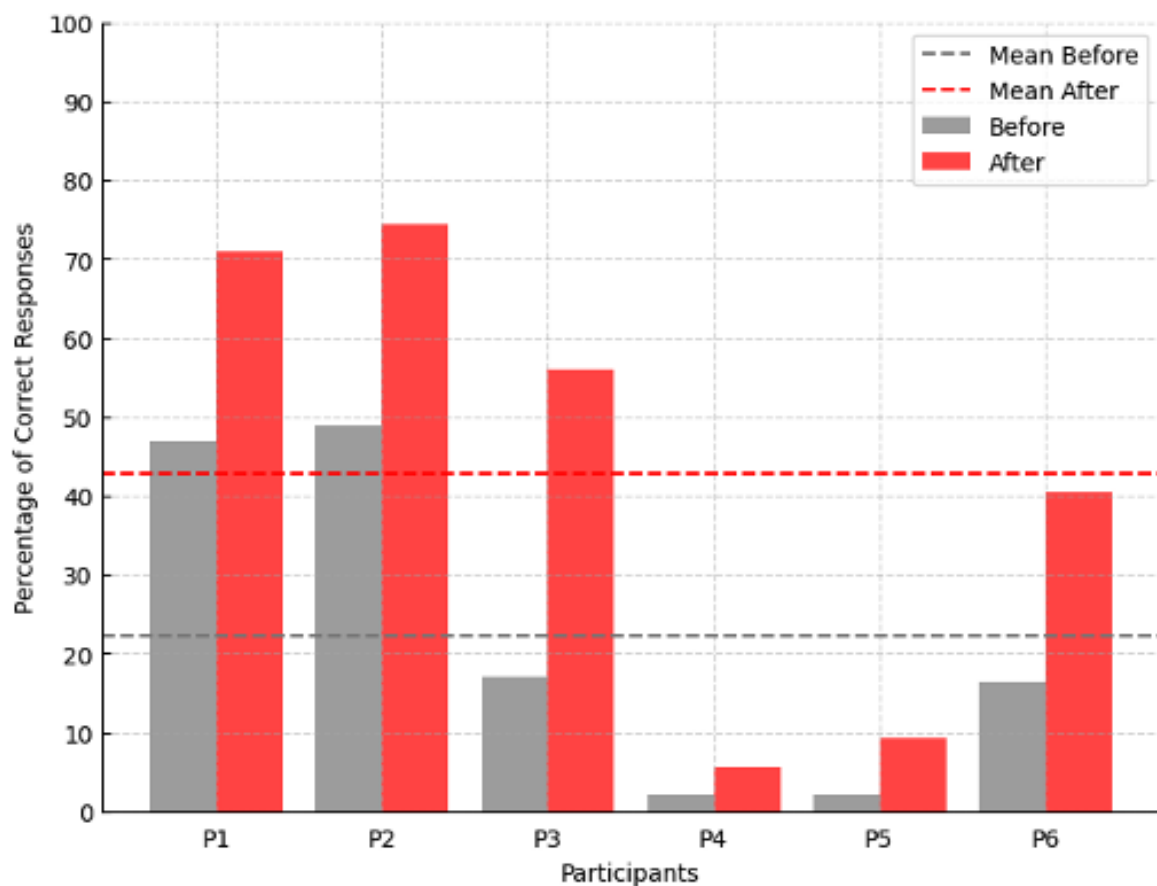
- Arheix-Parras, S., Barrios, C., Python, G., Cogné, M., Sibon, I., Engelhardt, M., Dehail, P., Cassoudeulle, H., Moucheboeuf, G., & Glize, B. (2021). A systematic review of repetitive transcranial magnetic stimulation in aphasia rehabilitation: Leads for future studies. *Neuroscience & Biobehavioral Reviews*, 127, 212-241.
- Kielar, A., Patterson, D., & Chou, Y.-H. (2022). Efficacy of repetitive transcranial magnetic stimulation in treating stroke aphasia: Systematic review and meta-analysis. *Clinical Neurophysiology*, 140, 196-227.
- Li, Y., Qu, Y., Yuan, M., & Du, T. (2015). Low-frequency repetitive transcranial magnetic stimulation for patients with aphasia after stroke: A meta-analysis. *Journal of Rehabilitation Medicine*, 47(8), 675-681.

Williams, E. E. R., Sghirripa, S., Rogasch, N. C., Hordacre, B., & Attrill, S. (2024). Non-invasive brain stimulation in the treatment of post-stroke aphasia: A scoping review. *Disability and Rehabilitation*, 46(17), 3802-3826.

Acknowledgments

This work was supported by the Social Sciences and Humanities Research Council of Canada [Grant number 435-2021-0687] to MAW and scholarships to MS by the Alzheimer Society of Canada [#0000000043]. HMA is supported by a fellowship from the *Fonds de recherche du Québec – Santé* [#281961].

Figure 1. Action Naming Percentages Before and After the Administration of the iTBS Stimulation Protocol



Combining personalized anomia intervention with computer-based spaced-retrieval training for PPA: Initial outcomes

Mara Steinberg Lowe^{1*}, and Amy Vogel-Eyny²

¹ Department of Linguistics and Communication Disorders, CUNY Queens College, Queens, NY, USA

² Department of Speech-Language Pathology and Audiology, CUNY Hunter College, New York, NY, USA

***corresponding author, mara.lowe@qc.cuny.edu**

Introduction

Anomia is among the earliest and most distressing symptoms for people living with primary progressive aphasia (PPA), a language-led neurodegenerative syndrome (Henry, et al., 2019). Existing anomia treatments are adapted from post-stroke aphasia models and lack a maintenance-based approach tailored to PPA's progressive nature (Henry, et al., 2019). Spaced retrieval training (SRT) is one approach to preserving maintenance of gains. Anki, a computerized, adaptive version of SRT, presents information to be recalled over increasing time intervals (Anki, n.d.). Research indicates that using an adaptive algorithm maximizes retention of learned content over a relatively short period of time (Haslam, et al., 2011).

This poster presents initial outcomes from a clinical trial designed to evaluate the feasibility and effectiveness of an intervention that combines a personalized and established language training program (Lexical Cascade Treatment; Henry, et al., 2019) with a computer-based SRT program for individuals with PPA. Standardized language assessments, patient-reported outcome measures and feasibility data were collected.

Methods

Participants. English-speaking participants diagnosed with semantic or logopenic PPA without concomitant motor speech impairments were included. One participant with moderate semantic PPA successfully completed the protocol. Data collection is ongoing for two additional participants (completion expected August 2025).

Stimuli. Individualized stimuli consisted of 48 personally-relevant words, distributed across 4 semantic categories, selected by the participant and care partners. Half the words were trained while the others were not. Half of the words in each set were randomly selected to be included in the home practice condition.

Procedure. This is a multiple baseline single-subject experimental design (Figure 1). During baseline sessions, personalized stimuli were probed to establish baseline performance and selected stimuli were randomized into trained and untrained sets. Images and text were added to Anki for the words assigned to that condition. During treatment, Lexical Cascade Treatment was provided for trained stimuli and participants practiced at home using Anki for 30 minutes each day. All stimuli were probed again one week and one month after the treatment. Speech, language and cognitive testing was completed before and after treatment.

Results

For participant 1, naming accuracy for trained stimuli combined with Anki improved by 21% between baseline and immediate post-testing and 10% between baseline and 1-

month follow-up (Table 1). Reaction time for responses decreased for trained words with and without Anki practice as compared to untrained words (Table 1). The participant completed all required session activities and spent 3.35 hours completing home training during the treatment phase.

On a posttreatment survey, the participant self-reported improvement in ability to name practiced items in pictures, describe objects and decreased frustration during communication with familiar people. All other items were marked as stable.

Conclusions

Preliminary data highlights the adherence to the protocol and ability to integrate Anki-based practice into intervention, demonstrating the feasibility of the approach while identifying areas for optimization. This poster will present initial findings from at least 3 participants and discuss lessons learned with an emphasis on how to personalize and adapt anomia treatment protocols for individuals with PPA.

References

- Anki—Powerful, intelligent flashcards. (n.d.). Retrieved March 26, 2025, from <https://apps.ankiweb.net/>
- Haslam, C., Hodder, K. I., & Yates, P. J. (2011). Errorless learning and spaced retrieval: How do these methods fare in healthy and clinical populations? *Journal of Clinical and Experimental Neuropsychology*, 33(4), 432–447.
- Henry, M. L., Hubbard, H. I., Grasso, S. M., Dial, H. R., Beeson, P. M., Miller, B. L., & Gorno-Tempini, M. L. (2019). Treatment for Word Retrieval in Semantic and Logopenic Variants of Primary Progressive Aphasia: Immediate and Long-Term Outcomes. *Journal of Speech, Language, and Hearing Research*, 62(8), 2723–2749.

Acknowledgments

This research was supported by funding from the PSC-CUNY Research Award [#TRADB-55-222] and the 2024 Outdrive Aphasia PPA Research Grant sponsored by the National Aphasia Association and Academy of Aphasia to Mara Steinberg Lowe and Amy Vogel-Eyny. The authors would like to thank Rachel Desir and Emily Sinner for their help with stimuli creation, data collection and data analysis.

Figure 1. Visualization of study design. Red circles indicate sessions with probe testing.



Table 1. Participant 1 preliminary data. (A) probe accuracy (percent correct averaged across sessions for each phase) and (B) percent of accurate responses produced in less than 5 seconds.

A)		Baseline	Post-treatment (1 week)	Post-treatment (1 month)
Condition				
Trained + Anki		63%	83%	72%
Trained + No Anki		58%	67%	58%
Untrained + Anki		71%	75%	64%
Untrained + No Anki		79%	72%	83%
B)		Baseline	Post-treatment (1 week)	Post-treatment (1 month)
Condition				
Trained + Anki		65%	90%	93%
Trained + No Anki		64%	86%	78%
Untrained + Anki		83%	85%	82%
Untrained + No Anki		73%	74%	82%

Theory of Mind Predicts Effective Conversation in Early Right Hemisphere Stroke

Andrea Suazo¹, Margaret Blake², and Tatiana Schnur^{1*}

¹ Physical Medicine & Rehabilitation, McGovern Medical School at UTHealth
Houston, Houston, TX, USA

² Communication Sciences & Disorders, University of Houston, Houston, TX, USA

*corresponding author, tatiana.schnur@uth.tmc.edu

Introduction

Individuals with chronic right hemisphere damage (RHD) demonstrate a relationship between understanding that other people hold knowledge different from one's own, known as Theory of Mind (ToM), and understanding implied information during conversation (e.g., ironic jokes, Winner et al., 1998; referring expressions, Balaban et al., 2016). Effective conversation requires knowing others' mental states to distinguish between one's own vs. shared knowledge (e.g., Sabbagh et al., 1999). However, whether ToM contributes to the production of effective conversation after RHD is unknown.

Here, we evaluated ToM abilities and goal-directed collaborative conversation at the acute and sub-acute stages of RHD due to stroke. We hypothesized that individuals with RHD and ToM deficits will not always distinguish between what they themselves know and what their conversation partner knows, leading to errors in tailoring conversation to their partner's perspective. By testing at the early stages of stroke recovery, we minimized confounds introduced by neural reorganization and compensatory strategies that complicate interpretation in chronic studies.

Methods

Thirty-two patients with RHD at median five days post-stroke (mean=17, range=1-57) and 16 matched controls (age and education p 's > 0.48) completed tasks and passed outlier testing. The conversation task involved two picture scenes with 12 differences between them. The subject and one of three coordinators collaboratively found differences without seeing the other's picture (Diapix; Baker & Hazan, 2011). We measured communicative success as the number of differences found in 4.5 minutes. We assessed ToM via a nonverbal false-belief task (Biervoye et al., 2018) which quantified *other*-ToM (spontaneously inferring others' perspective) and *self*-ToM (inferring others' perspective while managing conflict with own perspective). Interleaved control trials assessed input processing and working memory task demands. Participants additionally completed baseline general cognitive tasks assessing executive control and attention (Zelazo et al., 2013), visuospatial inattention (Mancuso et al., 2015; Kleinman et al., 2007), and working memory (Randolph, 1998). Patient performance was z-scored to that of controls.

Results

Using hierarchical linear mixed effects modeling, we first predicted communicative success with baseline fixed (age, years education, days post-stroke, and general cognitive task performance) and random (conversation partner identity) effects. No variables were significant. However, after adding ToM false-belief and control trial performance, the model significantly predicted more variance in communicative

success than the base model ($\chi^2(4) = 13.3$, $p = .01$; $\Delta R^2 = .13$). Critically, *self*-ToM false-belief and control trial scores emerged as significant predictors after adjusting for other variables (Table 1, Figure 1). The model explained 36% of the variance in communicative success with fixed effects alone, and 50% with both fixed and random effects.

Conclusions

For adults during early stages of RHD, theory of mind was a key predictor of communicative success above and beyond general cognitive and demographic factors. The ability to suppress one's own knowledge may be particularly important in conversation where speakers must adjust their communication based on what their partner does or doesn't know. This study provides the first empirical evidence linking effective conversation to theory of mind in the understudied clinical population of acute to subacute RHD.

References

- Baker, R., & Hazan, V. (2011). DiapixUK: Task materials for the elicitation of multiple spontaneous speech dialogs. *Behavior Research Methods*, 43(3), 761–770.
- Balaban, N., Friedmann, N., & Ariel, M. (2016). The effect of theory of mind impairment on language: Referring after right-hemisphere damage. *Aphasiology*, 30(12), 1424–1460.
- Biervoye, A., Meert, G., Apperly, I. A., & Samson, D. (2018). Assessing the integrity of the cognitive processes involved in belief reasoning by means of two nonverbal tasks: Rationale, normative data collection and illustration with brain-damaged patients. *PLoS One*, 13(5), e0196457.
- Kleinman, J. T., Newhart, M., Davis, C., Heidler-Gary, J., Gottesman, R. F., & Hillis, A. E. (2007). Right hemispatial neglect: Frequency and characterization following acute left hemisphere stroke. *Brain and Cognition*, 64(1), 50–59.
- Mancuso, M., Capitani, E., De Luca, G., Zoccolotti, P., & Bisiacchi, P. (2015). Italian standardization of the Apples Cancellation Test. *Neurological Sciences*, 36(7), 1233–1240.
- Radford, A., Kim, J. W., Xu, T., Brockman, G., McLeavey, C., & Sutskever, I. (2023). Robust speech recognition via large-scale weak supervision. In *International Conference on Machine Learning* (pp. 28492–28518). PMLR.
- Randolph, C. (1998). *Repeatable Battery for the Assessment of Neuropsychological Status*. Psychological Corporation.
- Sabbagh, M. A. (1999). Communicative intentions and language: Evidence from right- hemisphere damage and autism. *Brain and Language*, 70(1), 29–69.
- Winner, E., Brownell, H. H., Happé, F., Blum, A., & Pincus, D. (1998). Distinguishing lies from jokes: Theory of mind deficits and discourse interpretation in right hemisphere brain-damaged patients. *Brain and Language*, 62(1), 89–106.
- Zelazo, P. D., Bauer, P. J., & the NIH Toolbox Cognition Battery Team. (2013). II. NIH toolbox cognition battery (CB): Measuring executive function and attention. *Monographs of the Society for Research in Child Development*, 78(4), 16–33.

Acknowledgments

This project was supported by the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health under award number R01DC019828 to UTHealth Houston. We appreciate our participants and colleagues

for their continued collaboration at the stroke centers of Memorial Hermann, Houston Methodist, and Baylor St. Luke's Medical Center. We thank our research coordinators for their efforts in data collection, the Texas Advanced Computing Center at UT Austin, Kesha Pugalenth, and research assistants for transcription support, and John Magnotti for statistical model building assistance.

Figure 1. Adjusted variable plot showing the significant positive relationship between *self* theory of mind and communicative success after controlling for demographic and cognitive variables.

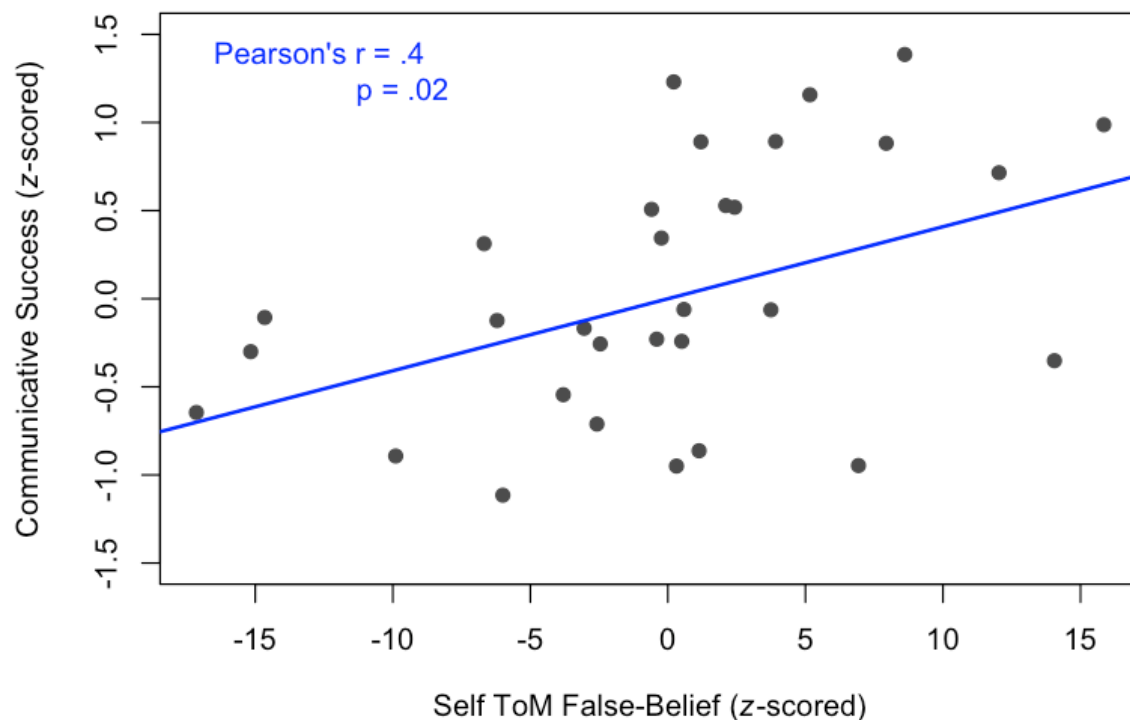


Table 1. Linear mixed effects model predicting communicative success. Bold indicates statistically significant at $p < .05$. CI = confidence interval, RV = residual variance, RIV = random intercept variance, ICC = intraclass correlation. Working memory assessed with the digit span (Randolph, 1998). Executive control and attention assessed with NIH Toolbox flanker (Zelazo et al., 2013). Visuospatial inattention assessed with composite performance on Ogden's scene copy (Kleinman et al., 2007) and the apples cancellation test (Mancuso et al., 2015).

<i>Fixed Effects</i>	<i>Estimates</i>	<i>std. Beta</i>	<i>95% CI</i>	<i>95% standardized CI</i>	<i>p</i>
(Intercept)	1.78	-0.04	[-1.89, 5.45]	[-0.65, 0.56]	.323
Age	-0.02	-0.29	[-0.05, 0.01]	[-0.73, 0.14]	.171
Years of Education	-0.03	-0.05	[-0.20, 0.15]	[-0.39, 0.29]	.769
Days Post-Stroke	0.01	0.25	[-0.01, 0.04]	[-0.12, 0.61]	.175
Working Memory	-0.16	-0.23	[-0.48, 0.16]	[-0.69, 0.23]	.312
Exec. Control/Attention	-0.01	-0.09	[-0.06, 0.04]	[-0.56, 0.38]	.692
Visuospatial Inattention	0.33	0.17	[-0.63, 1.29]	[-0.32, 0.66]	.477
<i>Other</i> ToM Control	-0.01	-0.05	[-0.11, 0.09]	[-0.49, 0.39]	.817
<i>Self</i> ToM Control	-0.12	-0.43	[-0.24, -0.00]	[-0.84, -0.01]	.044
<i>Other</i> ToM False-Belief	0.06	0.36	[-0.01, 0.13]	[-0.07, 0.79]	.097
<i>Self</i> ToM False-Belief	0.05	0.51	[0.01, 0.09]	[0.08, 0.94]	.022
<i>Random Effects</i>	<i>RV (σ^2)</i>	<i>RIV (τ_{00})</i>	<i>ICC</i>		
Coordinator (n=3)	.68	.19	.21		

Syntactic Complexity as a Behavioral Marker of Amyloid- β Positivity in Mild Cognitive Impairment

Jee Eun Sung^{1*}, Sujin Choi¹, Solmyeong Seo¹, Miryu Yoon², and Jee Hyang Jeong^{2,3*}

¹Department of Communication Disorders, Ewha Womans University, Seoul, Republic of Korea

²Department of Neurology, Ewha Womans University Seoul Hospital, Ewha Womans University, Seoul, Republic of Korea

³Department of Neurology, Ewha Womans University, College of Medicine, Seoul, Republic of Korea

*corresponding authors: jeesung@ewha.ac.kr, jjeong@ewha.ac.kr

Introduction

Mild cognitive impairment (MCI) is widely regarded as a prodromal stage of Alzheimer's disease (AD), with amyloid β (A β) plaques accumulating 10–20 years before symptom onset (Jack et al., 2013; Sperling et al., 2011). A β positivity in MCI is linked to a higher risk of progression to AD (Okello et al., 2009; Villemagne et al., 2013), but current detection methods such as PET or CSF analysis are costly and invasive. Linguistic markers that correlate with A β status offer a low-cost, non-invasive alternative for early risk identification. This study builds on prior findings that the Sentence Comprehension Test (SCT; Sung et al., 2020) can sensitively detect MCI regardless of biomarker status. We investigate whether SCT subtypes involving complex syntax also reflect A β positivity, aiming to identify a behavioral linguistic marker that could serve as a proxy for AD-related neuropathology.

Methods

Participants

A total of 70 participants with amnesic MCI (aMCI) were recruited. Clinical diagnoses were made by trained neurologists using the Seoul Neuropsychological Screening Battery (SNSB) (Kang et al., 2012). All participants underwent F-18 florbetaben PET (FBB-PET) imaging to determine amyloid status. Based on FBB-PET results, 33 were classified as A β -positive and 37 as A β -negative (Table 1).

Procedures

The SCT is a sentence–picture matching paradigm, that uses semantically reversible sentences. It includes three sentence types: 2-place (A2) and 3-place (A3) active sentences, and passive sentences (P). Each sentence type is presented in word orders—canonical (C) and non-canonical (NC)—resulting in six subtypes: A2-C, A2-NC, A3-C, A3-NC, P-C, and P-NC. Each subtype consists of six items, yielding a total score of 36. In addition, working memory (WM) was measured using the digit span tests (Kang et al., 2012).

Results

Comparisons of SCT scores between A β groups

The generalized linear mixed-effects model revealed no significant difference in overall SCT scores between the A β -positive ($M=26.79$, $SD=4.70$) and A β -negative groups ($M=27.76$, $SD=5.12$; $\beta=-0.065$, $SE=0.113$, $p=.562$).

Significant main effects were observed for all subtypes except P-C. Accuracy was significantly higher for A2-C, A3-C ($p < .001$), and lower for A2-NC, A3-NC and P-NC ($p < .001$), compared to the grand mean. Furthermore, a significant group $\times$ subtype interaction ($\beta = -0.29$, $SE = 0.10$, $p = .005$) revealed that accuracy on the P-NC was significantly lower in the A β -positive ($M = 3.24$, $SD = 1.54$) than the A β -negative group ($M = 4.14$, $SD = 1.49$).

Stepwise discriminant analysis

Stepwise discriminant analysis identified the optimal predictors for distinguishing between groups. Predictor variables included cognitive test scores (K-MMSE, WM) and six subtype scores from the SCT. The final model retained two significant predictors, K-MMSE and the P-NC score from the SCT, yielding a Wilks' lambda of .80 ($\chi^2 = 14.96$, $p < .001$). Classification accuracy was 70.3% for A β -negative and 60.6% for A β -positive individuals. Overall, 65.7% of the original cases were correctly classified by the model (Figure 1).

Conclusions

The current study revealed that the most syntactically complex structure—passive sentences with scrambled (non-canonical) word order—significantly distinguished A β -positive from A β -negative individuals with MCI. Furthermore, stepwise discriminant analysis identified the P-NC subtype and K-MMSE scores as key predictors, achieving a classification accuracy of 65.7%. These findings have important clinical implications: complex syntactic structures may serve as non-invasive, low-cost behavioral markers of AD-related pathology. As quick and scalable screening tools, such linguistic markers offer a clinically practical approach for early risk identification and timely intervention in routine healthcare settings.

References

- Jack, C. R., Knopman, D. S., Jagust, W. J., Petersen, R. C., Weiner, M. W., Aisen, P. S., ... & Trojanowski, J. Q. (2013). Tracking pathophysiological processes in Alzheimer's disease: an updated hypothetical model of dynamic biomarkers. *The lancet neurology*, 12(2), 207-216.
- Kang, Y. U., Jang, S. M., & Na, D. L. (2012). *Seoul Neuropsychological Screening Battery (SNSB-II)*, Seoul: Human Brain Research & Consulting Co.
- Okello, A., Koivunen, J., Edison, P., Archer, H. A., Turkheimer, F. E., Nagren, K., ... & Brooks, D. J. (2009). Conversion of amyloid positive and negative MCI to AD over 3 years: an 11C-PIB PET study. *Neurology*, 73(10), 754-760.
- Sperling, R. A., Aisen, P. S., Beckett, L. A., Bennett, D. A., Craft, S., Fagan, A. M., ... & Phelps, C. H. (2011). Toward defining the preclinical stages of Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer's & dementia*, 7(3), 280-292.
- Sung, J. E., Choi, S., Eom, B., Yoo, J. K., & Jeong, J. H. (2020). Syntactic complexity as a linguistic marker to differentiate mild cognitive impairment from normal aging. *Journal of Speech, Language, and Hearing Research*, 63(5), 1416-1429.
- Villemagne, V. L., Burnham, S., Bourgeat, P., Brown, B., Ellis, K. A., Salvado, O., ... & Masters, C. L. (2013). Amyloid β deposition, neurodegeneration, and cognitive decline in sporadic Alzheimer's disease: a prospective cohort study. *The Lancet Neurology*, 12(4), 357-367.

Acknowledgments

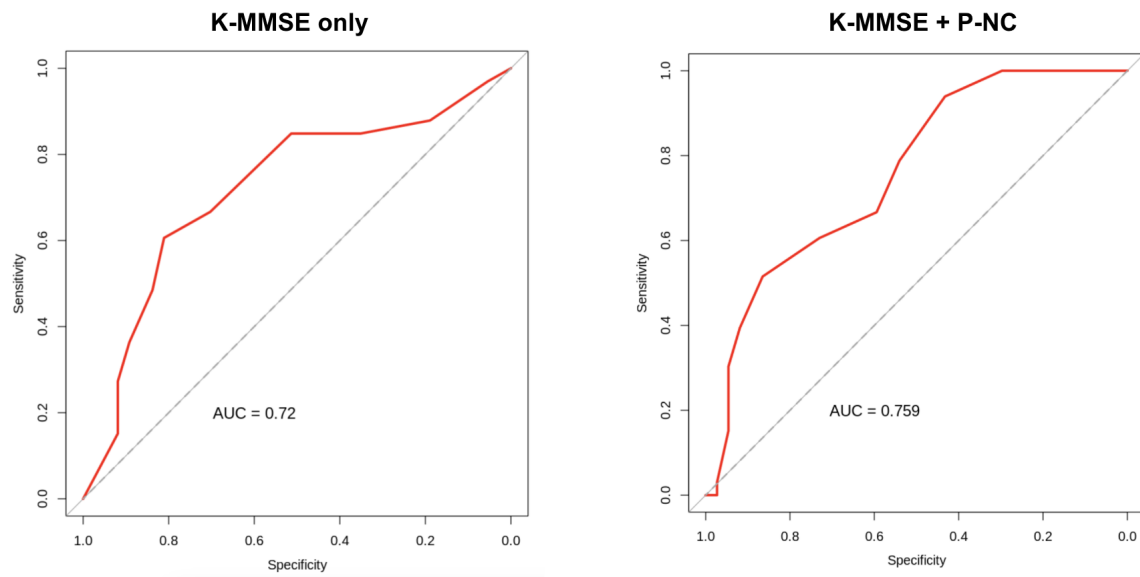
This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Ministry of Science and ICT (MSIT) (No. 2022R1A2C2005062, RS-2024-00461617), by the National Research Council of Science & Technology (NST) grant funded by MSIT (No. CAP21054-000), by the NRF grant funded by the Ministry of Education (No. NRF-2022R111A4063209), and by the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare (No. HI23C0156).

Table 1. Demographic information for each group

Characteristics	A β -positive group(n=33) Mean (SD)	A β -negative group(n=37) Mean (SD)	<i>t</i>	<i>p</i>
Gender (male: female)	10 : 23	12 : 25	-	-
Age (yrs)	66.67 (6.22)	69.18 (6.04)	-1.727	.089
Years of education	10.29 (3.88)	9.82 (5.08)	.426	.671
K-MMSE	23.91 (2.98)	26.21 (2.98)	-3.454	<.001***
DST-forward	5.70 (1.23)	5.92 (1.49)	-.671	.50
DST-backward	3.55 (.90)	3.86 (1.15)	-1.274	.20
SCT total	26.79 (4.70)	27.76 (5.18)	-.815	.418
SCT A2_C	5.76 (0.66)	5.70 (0.70)	.335	.739
SCT A2_NC	4.33 (1.68)	4.03 (1.62)	.773	.442
SCT A3_C	5.15 (0.93)	5.11 (1.07)	.179	.859
SCT A3_NC	3.52 (1.69)	3.78 (1.68)	-.663	.509
SCT P_C	4.79 (1.11)	5.00 (1.17)	-.772	.443
SCT P_NC	3.24 (1.54)	4.14 (1.49)	-2.459	.017**

Note. MCI=Mild Cognitive Impairment; SD=Standard Deviation; K-MMSE= Korean version of the Mini-Mental State Examination; DST=Digit Span Test; A2=Active sentences with 2-place verbs; A3=Active sentences with 3-place verbs; P=Passive sentences; C=Canonical word-order; NC=Non Canonical word-order. * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 1. ROC curves from stepwise discriminant models distinguishing between groups: (Left) model with K-MMSE only; (Right) model with K-MMSE and P-NC as significant predictors.



Evaluating Conceptual Models of Meaning in Semantic Feature Analysis: Evidence from fMRI and Representational Similarity Analysis

Alexander M. Swiderski^{1,2,3}, Michael Walsh Dickey^{1,2,3}, William D. Hula^{1,3}

¹Communication Science and Disorders, The University of Pittsburgh, Pittsburgh PA, USA

²The Center for Neural Basis of Cognition, Carnegie Mellon University, Pittsburgh PA, USA

³VA Pittsburgh Healthcare System, Pittsburgh PA, USA

*corresponding author, alexander.swiderski@va.gov

Introduction

Semantic Feature Analysis (SFA; Boyle & Coelho, 1995) is a common word production treatment for people with aphasia (PWA; Tierney-Hendricks et al., 2022), and its efficacy is supported by meta-analyses (e.g., Quique et al., 2019). Feature generation is an active ingredient of SFA (Boyle, 2010), and its mechanism is hypothesized to be spreading activation between semantic concepts (Boyle et al., 2022). Semantic models hypothesized to underpin this activation include taxonomic (category-based), distributional (word co-occurrence), and experiential (sensory, motor, and affective experiences) models. Prior studies suggest experiential models align closely with brain activity (Fernandino et al., 2022). Clarifying which semantic features align best with neural activation during SFA could refine treatment by guiding clinicians to prioritize prompts with robust neural engagement and deprioritize those with weaker correspondence. Using representational similarity analysis (RSA), we evaluated the alignment of semantic models with brain activation during feature generation in healthy adults and PWA.

Methods

Eight healthy adults (M = 57.5 years) and six chronic PWA (M = 63 years; CAT-MMT: M = 59.0) silently generated semantic features for 60 concrete nouns during fMRI. Stimuli were repeated up to 12 times per participant across runs. fMRI preprocessing was completed using fMRIPrep (Esteban et al., 2019). First-level GLMs computed item-specific beta maps, averaged across runs per participant, and included nuisance regressors for motion, drift, and anatomical CompCor components. Neural representational dissimilarity matrices (RDMs) were computed within a semantic ROI (Binder et al., 2009), using correlation distance and masked by lesion and tSNR maps. Semantic RDMs included five models: one taxonomic (WordNet; Fellbaum, 2010), two distributional (GloVe, Pennington et al., 2014; Word2Vec, Mikolov, 2013), and two experiential (Exp48, SM8; Binder et al., 2016). RSA involved partial correlations between neural and semantic RDMs, controlling for visual similarity (ResNet-50 embeddings; He et al., 2015) and remaining semantic models, isolating each model's unique contribution. Split-half reliability estimates from BOLD data served as noise ceilings, representing the maximum correlation expected between neural data and models given neural variability.

Results

Partial correlations (Figure 1) indicated the experiential Exp48 model showed the strongest alignment with neural data in both groups (controls: $M = .15$; PWA: $M = .14$), approaching the respective noise ceilings (controls: $M = .17$; PWA: $M = .13$). The SM8 experiential model showed weaker alignment (controls: $M = -.05$; PWA: $M = -.09$). Distributional models showed low alignment in both groups, and the taxonomic model (WordNet) performed poorest overall (controls: $M = -.06$; PWA: $M = -.09$).

Conclusions

Experiential 48, encompassing sensory, motor, and affective features, closely matched neural activation during semantic feature generation, nearing the upper bounds of measurable semantic alignment. The limited performance of SM8 suggests that broad Exp48, rather than narrowly defined sensory-motor dimensions, is more critical during SFA. Distributional and taxonomic models were less aligned with neural data, underscoring the limited role of abstract associations or categorical knowledge during feature generation, particularly in aphasia. Clinically, these findings support emphasizing experiential prompts in SFA to align interventions with neurocognitive mechanisms and optimize outcomes.

References

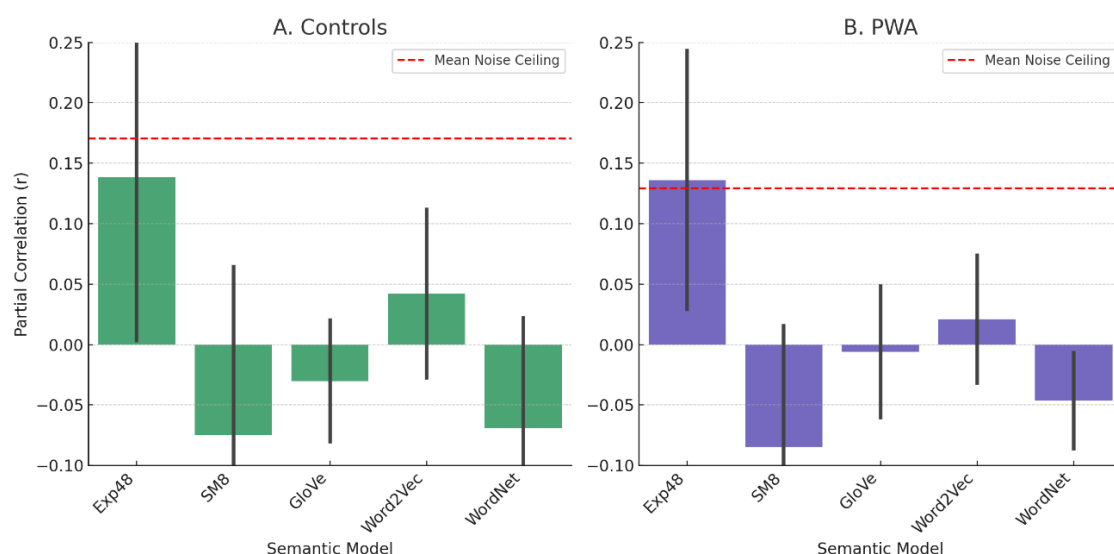
- Binder, J. R., Conant, L. L., Humphries, C. J., Fernandino, L., Simons, S. B., Aguilar, M., & Desai, R. H. (2016). Toward a brain-based componential semantic representation. *Cognitive Neuropsychology*, 33(3–4), 130–174. <https://doi.org/10.1080/02643294.2016.1147426>
- Boyle, M. (2010). Semantic Feature Analysis Treatment for Aphasic Word Retrieval Impairments: What's in a Name? *Topics in Stroke Rehabilitation*, 17(6), 411–422. <https://doi.org/10.1310/tsr1706-411>
- Boyle, M., & Coelho, C. A. (1995). Application of Semantic Feature Analysis as a Treatment for Aphasic Dysnomia. *American Journal of Speech-Language Pathology*, 4(4), 94–98. <https://doi.org/10.1044/1058-0360.0404.94>
- Boyle, M., Gordon, J. K., Harnish, S. M., Kiran, S., Martin, N., Rose, M. L., & Salis, C. (2022). Evaluating Cognitive-Linguistic Approaches to Interventions for Aphasia Within the Rehabilitation Treatment Specification System. *Archives of Physical Medicine and Rehabilitation*, 103(3), 590–598. <https://doi.org/10.1016/j.apmr.2021.07.816>
- Efstratiadou, E. A., Papathanasiou, I., Holland, R., Archonti, A., & Hilari, K. (2018). A Systematic Review of Semantic Feature Analysis Therapy Studies for Aphasia. *Journal of Speech, Language, and Hearing Research*, 61(5), 1261–1278. https://doi.org/10.1044/2018_JSLHR-L-16-0330
- Esteban, O., Markiewicz, C. J., Blair, R. W., Moodie, C. A., Isik, A. I., Erramuzpe, A., Kent, J. D., Goncalves, M., DuPre, E., Snyder, M., Oya, H., Ghosh, S. S., Wright, J., Durnez, J., Poldrack, R. A., & Gorgolewski, K. J. (2019). fMRIPrep: A robust preprocessing pipeline for functional MRI. *Nature Methods*, 16(1), 111–116. <https://doi.org/10.1038/s41592-018-0235-4>
- Evans, W. S., Cavanaugh, R., Gravier, M. L., Autenreith, A. M., Doyle, P. J., Hula, W. D., & Dickey, M. W. (2021). Effects of Semantic Feature Type, Diversity, and Quantity on Semantic Feature Analysis Treatment Outcomes in Aphasia. *American Journal of Speech-Language Pathology*, 30(1S), 344–358. https://doi.org/10.1044/2020_AJSLP-19-00112

- Fellbaum, C. (2010). WordNet. In R. Poli, M. Healy, & A. Kameas (Eds.), *Theory and Applications of Ontology: Computer Applications* (pp. 231–243). Springer Netherlands. https://doi.org/10.1007/978-90-481-8847-5_10
- Fernandino, L., Tong, J.-Q., Conant, L. L., Humphries, C. J., & Binder, J. R. (2022). Decoding the information structure underlying the neural representation of concepts. *Proceedings of the National Academy of Sciences*, 119(6), e2108091119. <https://doi.org/10.1073/pnas.2108091119>
- Mikolov, T. (2013). Efficient estimation of word representations in vector space. *arXiv Preprint arXiv:1301.3781*, 3781.
- Pennington, J., Socher, R., & Manning, C. D. (2014). Glove: Global vectors for word representation. *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 1532–1543.
- Quique, Y. M., Evans, W. S., & Dickey, M. W. (2019). Acquisition and Generalization Responses in Aphasia Naming Treatment: A Meta-Analysis of Semantic Feature Analysis Outcomes. *American Journal of Speech-Language Pathology*, 28(1S), 230–246. https://doi.org/10.1044/2018_AJSLP-17-0155
- Tierney-Hendricks, C., Schliep, M. E., & Vallila-Rohter, S. (2022). Using an Implementation Framework to Survey Outcome Measurement and Treatment Practices in Aphasia. *American Journal of Speech-Language Pathology*, 31(3), 1133–1162. https://doi.org/10.1044/2021_AJSLP-21-00101

Acknowledgments

We are greatly appreciative for the individuals who participated in this study. The primary investigator of this study receives funding from NIH-NIDCD: F31 DC021613. Data collection and participant payments were supported by a William Orr Dingwall award, Carnegie Mellon University Jump Start award, and a University of Pittsburgh Clinical and Translational Science Institute Pilot grant.

Figure 1. RSA partial correlation



Factors determining the successful use of AI-based AAC tool in patient with aphasia- a case report

Nobuhiro Takatsu^{1,2*}, Michiyuki Kawakami^{1,3}, Nami Tamura², Emiri Kase³, Mari Ito³, Kunitsugu Kondo^{1,3}

¹Department of Rehabilitation Medicine, School of Medicine, Keio University, Shinanomachi, Tokyo, Japan.

²Department of Speech, Language and Hearing Therapy, Tokyo Bay Rehabilitation Hospital, Narashino, Chiba, Japan.

³Department of Rehabilitation Medicine, Tokyo Bay Rehabilitation Hospital, Narashino, Chiba, Japan.

*Nobuhiro Takatsu, lang.nobu@gmail.com

Introduction

Producing grammatical and pragmatically appropriate sentence is one of the most challenging aspects for people with aphasia (PWA). A systematic review (Cistola et al., 2021) shows high-tech augmentative and alternative communication (AAC) tools are not effective to process complex sentences. Japanese employs complex systems to express politeness, which are essential for maintaining respectful interpersonal relationships. This case report describes a PWA who experienced difficulties in producing polite expressions and successfully addressed it through the use of an existing AI-based AAC tool. The report also discusses the factors contributing to the successful application of the tool.

Case

A 38-year-old man suffered a stroke 9 month ago. He has a residual aphasia (Japanese version of WAB AQ=74; Spontaneous speech=17/20; Auditory verbal comprehension=5.7/10; Repetition=5.1/10; Naming and word finding=9.3/10; Reading=10/10; Writing=8/10), but the cognitive functions were intact (Raven's Coloured Progressive Matrices=36/36, Kohs Block Design Test IQ=120). While sentence level writing was possible, grammatical errors or pragmatically inappropriate expressions remained.

These high-level writing skills were essential for his independent living, particularly in administrative tasks such as applying for public health-insurance service and negotiating a return to occupation. To address these issues, an existing AI-based AAC tool, called *3-byo-Keigo* (3-seconds-politeness form) was utilized. It was originally designed for healthy individuals to help them transform texts into polite forms. The application revised his original written outputs into correct and contextually appropriate formats, suitable for professional or administrative communications. Although his grammatical and pragmatic impairment remains, with the application's support, he is currently in the process of returning to the workplace.

Discussion

In Japanese, politeness expression system is highly complicating, requiring the use of specific verbs, passive form, and/or suffixation depending on types of polite language, namely, honorific language, humble language, and polite language. Due to these linguistic demands, it is one of the most persistent linguistic challenges for PWA. His

original sentences included inappropriate verbs and lack of contextually necessary information. These problems were solved through the use of AI-based tool.

Several factors appeared to contribute to the effective use of high-tech AAC tool. His cognitive function was intact, allowing him to make strategic decisions to use the AAC tool. His language skills were sufficient to generate original messages containing adequate information, based on his preserved naming ability. Moreover, his reading ability enabled him to evaluate the accuracy and appropriateness of the AI-generated output. Environmentally, he possessed technological literacy and devices (PC and smartphone) required to operate the AAC application. Furthermore, there were numerous occasions where it was necessary to employ polite and grammatical expressions in written discourse, creating a strong motivation.

Conclusions

Factors contributing to the effective use of AI-based AAC tools compensating for grammatical and pragmatic errors are intact cognition, sufficient language skills to produce semantically rich input, familiarity with digital devices, and frequent need of high-level writing. Advances in generative AI hold promise for extending the functional capacity of PWA, particularly in complex communicative domains, thereby supporting social reintegration and enhancing quality of life.

References

- Cistola, G., Farrús, M., & Meulen, I. (2021). Aphasia and acquired reading impairments: What are the high-tech alternatives to compensate for reading deficits?. *International journal of language & communication disorders*, 56(1), 161-173.

Mapping and decoding semantic representations in aphasia after stroke

Jerry Tang^{1*}, Carly Millanski¹, Lisa D. Wauters¹, Shilpa Shamapant², Stephen M. Wilson³, Alexander G. Huth^{4,5}, and Maya L. Henry^{1,6}

¹ Department of Speech, Language, and Hearing Sciences, University of Texas at Austin, Austin, Texas, USA

² Austin Speech Labs, Austin, Texas, USA

³ School of Health and Rehabilitation Sciences, University of Queensland, Brisbane, Queensland, Australia

⁴ Department of Computer Science, University of Texas at Austin, Austin, Texas, USA

⁵ Department of Neuroscience, University of Texas at Austin, Austin, Texas, USA

⁶ Department of Neurology, University of Texas at Austin Dell Medical School, Austin, Texas, USA

***corresponding author, jerrytang@utexas.edu**

Introduction

People with aphasia often report knowing what they want to say but not being able to say it. This suggests that semantic representations are relatively preserved but the mapping to lexical-phonological output is disrupted (Fama et al., 2017). One potential way to help people with aphasia is to predict what they want to say by decoding their semantic representations. Semantic decoding has been demonstrated in neurologically healthy participants by using naturalistic stimuli to map the concepts that are encoded in each cortical region (Tang et al., 2023). Given new brain responses, these semantic maps can be used to predict the concepts that the participants are thinking about. However, most neuroimaging studies in participants with aphasia have relied on controlled stimuli that lack the conceptual coverage required to map the semantic system. As a result, it is unclear whether semantic representations are sufficiently preserved to be accurately decoded.

Methods

We used functional magnetic resonance imaging (fMRI) to record brain responses from two participants with stroke-induced aphasia and three neurologically healthy controls. One participant had mild-moderate aphasia predominantly affecting language production, while the other had severe expressive-receptive aphasia and motor speech impairment. All participants watched one hour of silent movies and listened to three hours of narrative stories. We separately recorded brain responses from the neurologically healthy controls while they listened to a larger set of narrative stories. We used the larger set of narrative stories to train voxelwise encoding models and semantic decoding models. We finally transferred these models from the neurologically healthy controls to the participants with aphasia by functionally aligning their brain responses to the shared movies and stories (Tang & Huth, 2025).

Results

To assess how the functional neuroanatomy of speech-language processing is affected in aphasia, we compared prediction performance across encoding models that capture information from different linguistic levels (Vaidya et al., 2022). We found that semantically selective regions are consistent between participants with aphasia

and the neurologically healthy controls in spared cortical regions. To assess how the organization of the semantic system is affected in aphasia, we visualized the weights of a lexical semantic encoding model, which predict the concepts that are encoded in each cortical region (Huth et al., 2016). We found that the organization of semantic concepts is also consistent between participants with aphasia and the neurologically healthy controls in spared cortical regions. To test whether semantic representations can be decoded in people with aphasia, we applied the semantic decoders to brain responses while the participants watched new movies and listened to new stories. We found that the decoders could successfully recover the gist of the movies and stories.

Conclusions

Our results indicate that people with stroke-induced aphasia can have preserved semantic representations, and that the organization of these representations is largely consistent with that of neurologically healthy controls. These results demonstrate the potential for semantic brain-computer interfaces to improve communication in people with aphasia.

References

- Fama, M. E., Hayward, W., Snider, S. F., Friedman, R. B., & Turkeltaub, P. E. (2017). Subjective experience of inner speech in aphasia: Preliminary behavioral relationships and neural correlates. *Brain and Language*, 164, 32–42.
- Huth, A. G., de Heer, W. A., Griffiths, T. L., Theunissen, F. E., & Gallant, J. L. (2016). Natural speech reveals the semantic maps that tile human cerebral cortex. *Nature*, 532(7600), 453–458.
- Tang, J., & Huth, A. G. (2025). Semantic language decoding across participants and stimulus modalities. *Current Biology*, 35(5), 1023–1032.e6.
- Tang, J., LeBel, A., Jain, S., & Huth, A. G. (2023). Semantic reconstruction of continuous language from non-invasive brain recordings. *Nature Neuroscience*, 26(5), 858–866.
- Vaidya, A. R., Jain, S., & Huth, A. G. (2022). Self-supervised models of audio effectively explain human cortical responses to speech. *Proceedings of the 39th International Conference on Machine Learning*.

Acknowledgments

Jerry Tang is supported by NIH/NIDCD F32DC022178. Additional support comes from NIH/NIDCD R01DC016291 (Henry) and NIH/NIDCD R01DC020088 (Huth). We sincerely thank our participants for their time and generosity.

Figure 1. Decoder predictions from brain responses to perceived stories and movies can recover the gist of the stimuli.

True stimulus	Decoder prediction	True stimulus	Decoder prediction
you're like a mile and a half from home and if you walk three streets over you'll be back on that pretty street	i don't have to take you to your house you can use the car to get there from your home which is on a side road	 	i notice he has a knife and i'm like ok and he grabs it and i think so he says don't hurt him
i was like okay this is it i'm gonna have my first kiss tonight we're gonna get married the summer after graduation	i had just started dating and we were hanging out after i got over it i had a few weeks left until i was going to get married	 	i say he needs to keep it up because it hurts i can't hold it anymore and i have to let go

Co-occurring Impairments in Object Decision and Kanji Lexical Decision following Left Temporo-Occipital Stroke: A Single-Case Study

Ayane Tateba^{1,2*}, Kosei Hashimoto³, Takahiro Okazaki⁴, Koichi Ikeno⁴
and Mutsuo Ijuin⁵

¹ Department of Rehabilitation, JCHO Kumamoto General Hospital, Kumamoto, Japan

² Graduate School of Comprehensive Scientific Research, Prefectural University of Hiroshima, Hiroshima, Japan

³ Department of Speech, Language and Hearing Therapy, Mejiro University, Saitama, Japan

⁴ Department of Neurology, JCHO Kumamoto General Hospital, Kumamoto, Japan

⁵ Department of Communication Sciences and Disorders, Prefectural University of Hiroshima, Hiroshima, Japan

*corresponding author, Ayane10203210@gmail.com

Introduction

The Object Decision Task (ODT) and the Lexical Decision Task (LDT) both require a judgment about the 'realness' of a stimulus, yet each has traditionally been applied to different clinical domains—visual object recognition and orthographic processing, respectively (Kroll & Potter., 1984). Functional-MRI studies have revealed partial overlap between the neural substrates for object form and visually presented Kanji words in the left lateral occipitotemporal cortex and ventral temporal regions (Nakamura et al., 2005). Because Kanji and Kana engage distinct neural networks (Ino et al., 2009), objects and Kanji may be co-impaired while Kana remains intact; however, patient evidence is scarce. We therefore examined ODT and visual and auditory lexical decision tasks performance in a single patient with a left temporo-occipital lesion.

Methods

Participant: A right-handed Japanese woman in her 60s with 12 years of education participated in the study during hospitalization for symptomatic epilepsy. She had a chronic infarct involving the left temporal and occipital lobes. Testing began nine days after admission. General non-verbal reasoning was normal on the Raven Coloured Progressive Matrices. Assessments included: (i) Birmingham Object Recognition Battery (BORB) Object Decision (128 items); (ii) The Sophia Analysis of Language in Aphasia (SALA ; Japanese version of the Psycholinguistic Assessment of Language Processing in Aphasia) Lexical Decision for Kanji (152 items), Kana (64 items) and Auditory words (104 items); (iii) SALA reading aloud of Kanji and Kana. The Lexical Decision Task and the Reading Aloud Task included both Hiragana and Katakana stimuli. Accuracy was recorded for each subtest.

Results

ODT accuracy was 79.8 % (101/128), below the -2 SD cut-off of 104 (norm = 114.7 ± 5.7). Correct responses for real objects were 90.6 % whereas non-real objects were 65.6 %. Kanji LDT accuracy was similarly reduced (79.6 %, 121/152). In contrast, Kana LDT (100 %, 64/64) and Auditory LDT (97.1 %, 101/104) were within

normal limits. In the reading aloud task, legitimate alternative reading of components (LARC) errors were observed in Kanji.

Conclusions

Concurrent impairment on the ODT and Kanji LDT, alongside intact Kana and auditory lexical decisions, indicates selective disruption of visual–structural representations shared by objects and Kanji. The pattern accords with damage to overlapping regions in the left lateral occipitotemporal and ventral temporal cortices supporting object shape analysis and the visual word-form area. (Malach et al., 1995; Nakamura et al., 2000; Cohen et al., 2008; Higuchi et al., 2015). These findings reinforce the proposal of partially shared neural circuitry for object and Kanji recognition. They also highlight the clinical value of combining ODT with script-specific LDTs when evaluating brain-damaged Japanese patients with left temporo-occipital lesions.

References

- Kroll, J. F., & Potter, M. C. (1984). Recognizing words, pictures, and concepts: A comparison of lexical, object, and reality decisions. *Journal of Verbal Learning and Verbal Behavior*, 23(1), 39–66.
- Nakamura, K., Oga, T., Okada, T., Sadato, N., Takayama, Y., Wydell, T., Yonekura, Y., & Fukuyama, H. (2005). Hemispheric asymmetry emerges at distinct parts of the occipitotemporal cortex for objects, logograms and phonograms: A functional MRI study. *NeuroImage*, 28(3), 521–528.
- Ino, T., Nakai, R., Shimojo, M., & Sadato, N. (2009). Shared neural substrates for object and Kanji perception in the left ventral temporal cortex: An fMRI study. *Brain and Language*, 110(3), 166–175.
- Malach, R., Reppas, J. B., Benson, R. R., Kwong, K. K., Jiang, H., Kennedy, W. A., ... & Tootell, R. B. (1995). Object-related activity revealed by functional magnetic resonance imaging in human occipital cortex. *Proceedings of the National Academy of Sciences*, 92(18), 8135–8139.
- Cohen, L., Dehaene, S., Vinckier, F., Jobert, A., & Montavont, A. (2008). Reading normal and degraded words: Contribution of the dorsal and ventral visual pathways. *Neuron*, 57(2), 270–282.
- Nakamura, K. (2000). Neural substrates for Kanji word identification: A functional MRI study. *NeuroReport*, 11(3), 329–332.
- Higuchi, M., Sakai, K., Kira, R., & Asahina, M. (2015). Neural basis of hierarchical visual form processing of Japanese Kanji characters. *NeuroImage*, 113, 175–186.

Acknowledgments

This work was supported in part by Grants-in-Aid for Scientific Research (KAKENHI) awarded to K. Hashimoto (25K20910). The authors thank the patient and her family for their generous participation.

“Overwhelmed But Curious”
Care Partner Perspectives on Education, Resources, and Coping after Aphasia
Diagnosis Based on Preliminary Data

Grace E. Terry, Jennifer Brello, & Stacy M. Harnish

¹ Department of Speech and Hearing Science, The Ohio State University, Columbus,
Ohio, USA

***Grace Terry, terry.310@osu.edu**

Introduction

Care partners of people with aphasia (PWA) are faced with unique challenges, as their loved one's loss of communication may create specific barriers to interaction, expression, and mutual understanding (Simmons-Mackie et al., 2010). Previous research has investigated the challenges faced by care partners of PWA, however, there is limited research that investigates the perceived needs of these care partners. The present study investigates the perspectives of care partners on their loved one's aphasia diagnosis and the learning process that comes with it through two primary aims. The first of which is to identify common themes relating to the challenges and rewards of being a care partner of a person with aphasia, as well as themes relating to care partner resilience and well-being. Secondly, we aim to identify perceived education gaps or resources per the experiences of care partners of people with aphasia. In doing so, we plan to highlight the complexities of the experience of living as a care partner of someone with aphasia.

Methods

The present analysis contains data from nine care partners of adults with post stroke aphasia, who are greater than 6 months post diagnosis. See table one for demographic information including nature of relationships. Semi-structured focus groups containing care partners of PWA were conducted to gather a variety of qualitative data from participants. Focus group transcripts were transcribed by the primary researcher. Data were coded using a reflexive approach to thematic analysis founded by Braun and Clarke (2006).

Results

Three main themes arose during thematic analysis.

Theme #1: Education and Information are critical areas of need for care partners of people with aphasia.

Theme #2: Being a care partner for a person with aphasia is both challenging and rewarding.

Theme # 3: The presence of a support system can influence the perceived well-being and resilience of care partners of people with aphasia.

Each theme was found to have corresponding subthemes which highlight the complexities of the caregiving experience.

Conclusions

During semi-structured focus groups care-partners highlighted areas of perceived need and support. These areas include gaps in education, a lack of dissemination of research, and the need for increasing mental health supports and readily available

resources for care partners themselves, and people with aphasia. Care-partners identified rewarding aspects of being a care partner, such as new growth and increased confidence in loved ones, as well as challenges, such as patience and adjustment to change. Care-partners reported their support systems as one of the most significant factors in their personal well-being, emphasizing the importance of social connection in overall wellness. First-hand accounts of care partners in this study serve as a guide for clinicians, as well as an important call to action for future studies, as they may guide aphasiologists towards the areas care partners perceive as most needed.

References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Grawburg, M., Howe, T., Worrall, L., & Scarinci, N. (2013). Third-party disability in family members of people with aphasia: A systematic review. *Disability and rehabilitation*, 35(16), 1324-1341.
- Grawburg, M., Howe, T., Worrall, L., & Scarinci, N. (2019). Family-centered care in aphasia: Assessment of third-party disability in family members with the family aphasia measure of life impact. *Topics in Language Disorders*, 39(1), 29-54.
- Shafer, J. S. (2021). *Timing Matters: Information Preference of Care Partners for People with Aphasia After Stroke* (Doctoral dissertation, The University of North Carolina at Chapel Hill).
- Simmons-Mackie, N., Raymer, A., Armstrong, E., Holland, A., & Cherney, L. R. (2010). Communication partner training in aphasia: A systematic review. *Archives of physical medicine and rehabilitation*, 91(12), 1814-1837.
- Winkler, M., Bedford, V., Northcott, S., & Hilari, K. (2014). Aphasia blog talk: How does stroke and aphasia affect the carer and their relationship with the person with aphasia?. *Aphasiology*, 28(11), 1301-1319.

Acknowledgments

This study was funded by the department of speech and hearing science at the Ohio State University

Table 1. Participant Demographics

Demographic Factor	Average
Gender (%)	8 female (88.89%); 1 male (11.11%)
Race (%)	6 White (66.67%); 3 black (33.33%)
Working/Retired (%)	5 working (55.56%); 4 retired (44.44%)
Relationship to PWA (%)	7 spouse (77.78%); 2 child (22.22%)
Mean Income (\$)	\$92,444.45
Mean Education (years)	16.12 years
Mean time as care partner	8.22 years

Mapping Patient Linguistic Profiles to Neurological Conditions using AI

Charalambos Themistocleous¹ and Brielle Stark²

¹Department of Special Needs Education, University of Oslo, Oslo, Norway

²Department of Speech, Language and Hearing Sciences, Indiana University
Bloomington, IN 47408

Introduction

Language impairment is a common symptom across various neurological conditions, including left hemisphere (LH) stroke, Mild Cognitive Impairment (MCI), dementia, and Traumatic Brain Injury (TBI). Traditional neurological assessments face limitations such as restricted clinical time, administrative burden, and high costs, making manual evaluations challenging (Stark et al., 2021). Recent advances in Artificial Intelligence (AI) provide opportunities to overcome these limitations and broaden the scope of neurological assessment (Themistocleous, 2024). This study investigates how computational language analysis of spoken discourse tasks can differentiate language impairments, providing deeper clinical insights than conventional methods.

Methods

Speech samples were collected from TalkBank's Clinical Banks, encompassing multiple discourse genres. The dataset included: 518 individuals with aphasia due to left hemisphere stroke (LHS), 193 individuals with dementia (Pitt cohort), 107 with MCI (41 from the Delaware project and 66 from DementiaBank), 38 with right hemisphere stroke (RHS), 58 with TBI, and 582 healthy controls (HC) (MacWhinney et al., 2011). Using the Open Brain AI platform (<http://openbrainai.com>), we extracted domain-specific measures assessing readability, lexical production, phonological features, morphology, syntax, and semantics. To analyze the data, we employed mixed-effects modeling to examine the influence of clinical diagnosis and Machine Learning (ML) to evaluate diagnostic potential. We addressed dataset imbalance SMOTE and reduced dimensionality via Principal Component Analysis (PCA). Five ML models—Decision Tree, Random Forest, Support Vector Machine (SVM), Gradient Boosting, and Logistic Regression—were optimized through hyperparameter tuning.

Results

Compared to healthy controls (HCs), individuals with LHS exhibited widespread deficits. Phonologically, they produced fewer syllables and simpler syllable structures. Morphologically, they showed reduced counts across most parts-of-speech and inflectional categories. Syntactically, their language was less complex, with lower readability scores, shorter sentences, and simplified syntax. Unexpectedly, individuals with MCI demonstrated increased lexical richness and syntactic complexity. They produced more syllables, complex phonological structures, and higher counts of parts-of-speech and syntactic constructions. However, their Type-Token Ratio (TTR) was lower, indicating lexical repetition despite greater word output. Individuals with dementia displayed pervasive but less severe impairments than those with LHS, including reduced lexical diversity and simplified readability metrics. In contrast, individuals with RHS and TBI showed minimal differences from HCs, with only selective deficits.

Machine learning classification achieved over 80% accuracy, confirming that computational measures effectively distinguish between neurological conditions.

Conclusions

Automated speech analysis reliably differentiates language profiles across neurological conditions, offering deeper clinical insights than traditional assessments. The study confirmed broad impairments in aphasia and dementia, while revealing unexpectedly verbose yet repetitive language in MCI—possibly indicating compensatory mechanisms. RHS and TBI cases showed largely preserved language with minor deficits. The high accuracy of ML models underscores the potential of condition-specific markers to enhance diagnosis, guide rehabilitation, and enable early detection of cognitive decline. These findings highlight AI's transformative role in neurological assessment, improving both precision and accessibility in clinical practice.

References

- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for studying discourse. *Aphasiology*, 25(11), 1286-1307.
<https://doi.org/10.1080/02687038.2011.589893>
- Stark, B. C., Dutta, M., Murray, L. L., Fromm, D., Bryant, L., Harmon, T. G., Ramage, A. E., & Roberts, A. C. (2021). Spoken discourse assessment and analysis in aphasia: An international survey of current practices. *Journal of Speech, Language, and Hearing Research*, 64(11), 4366-4389.
<https://pmc.ncbi.nlm.nih.gov/articles/PMC9132151/>
- Themistocleous, C. (2024). Open Brain AI and language assessment. *Frontiers in Human Neuroscience*, 18. <https://doi.org/10.3389/fnhum.2024.1421435>

Naming treatment in aphasia: How individual differences and error types predict response to retrieval practice and errorless learning

Yingxue Tian^{1*}, Marja-Liisa Mailend^{1,2}, Daniel Mirman³, and Erica L. Middleton¹

¹ Jefferson Moss Rehabilitation Research Institute, Elkins Park, Pennsylvania, USA

² Department of Special Education and Speech Therapy, University of Tartu, Tartu, Estonia

³ Department of Psychology, University of Edinburgh, Edinburgh, UK

***Corresponding author: yingxue.tian@jefferson.edu**

Introduction

Naming impairment is ubiquitous in post-stroke aphasia, often resulting from *lexical access disorder* – difficulty mapping between semantics and words (Stage 1) and/or between words and phonology (Stage 2). Two treatment approaches, retrieval practice (RP) and errorless learning (EL), leverage distinct learning principles to support naming recovery. RP prompts retrieval from long-term memory (e.g., naming an object from its picture), engaging both naming stages. In contrast, EL emphasizes Stage 2 mapping (e.g., repeating the name of a picture after hearing it), relying less on semantics-driven retrieval.

RP often leads to superior naming performance over EL in selected groups of people with aphasia (PWA) whose naming impairments are attributable to lexical access disorder, though treatment responses vary across error types and individual (Middleton et al., 2015; Middleton et al., 2016; Middleton et al., 2019; Schuchard & Middleton, 2018a; Schuchard & Middleton, 2018b). Because RP and EL differentially engage the two stages of naming, they may selectively improve errors from different stages (Schuchard & Middleton, 2018a; 2018b). Additionally, little is known about how individual differences in major processing stages of naming influence the benefits from RP versus EL. Through the lens of precision rehabilitation, this study investigates how (1) pre-treatment error types and (2) individual differences in cognitive-linguistic abilities predict responsiveness to RP versus EL.

Methods

A naming treatment study was conducted with 30 unselected PWA. To select treatment items, a 660-item common objects picture corpus was administered twice for naming assessment, with responses coded as correct, phonological (Stage 2) errors, semantic (Stage 1) errors, and other errors. Each PWA's personalized 120-items set was evenly assigned to RP and EL conditions in a matched fashion. Naming performance on treated items was assessed the next day and one week later.

For error-type analyses, each treated word was coded into one of six categories based on two responses during item selection: correct, pure Stage 1, blended Stage 1, pure Stage 2, blended Stage 2, and unclear.

For individual differences analyses, data were combined across three studies with similar designs (48 participants total). Six cognitive-linguistic composite variables were assessed: input and output semantic and phonological processing abilities, naming severity, and verbal short-term memory (STM).

We used separate multilevel logistic mixed-effects models to investigate how (1) pre-treatment error types or (2) individual's cognitive-linguistic abilities interacted with treatment type (RP versus EL) to predict post-treatment naming accuracy.

Results

In the error-type model, RP outperformed EL for pure Stage 1, blended Stage 1, and blended Stage 2 errors on the day following treatment. At the one-week follow-up, RP maintained its advantage for pure Stage 1 errors and correct items. In the individual differences model, higher verbal STM capacity predicted greater benefit from RP over EL.

Conclusions

Clinically, RP is particularly beneficial for items affected by Stage 1 dysfunction and for individuals with higher STM. Theoretically, learning in lexical access is stage-specific and use-dependent, with treatment strengthening the stage it directly engages. Findings also highlight the role of STM in learning, potentially by bolstering semantic-driven retrieval during RP in lexical access, integrating successful retrievals into long-term representations, and/or facilitating learning from feedback after unsuccessful retrievals.

References

- Middleton, E.L., Rawson, K.A., & Verkuilen, J. (2019). Retrieval practice and spacing effects in multi-session treatment of naming impairment in aphasia. *Cortex*, 119, 386-400.
- Middleton, E.L., Schwartz, M.F., Rawson, K.A., Garvey, K. (2015). Test-enhanced learning versus errorless learning in aphasia rehabilitation: Testing competing psychological principles. *Journal of Experimental Psychology-Learning Memory and Cognition*, 41(4), 1253-1261.
- Middleton, E.L., Schwartz, M.F., Rawson, K.A., Traut, H., & Verkuilen, J. (2016). Towards a theory of learning for naming rehabilitation: Retrieval practice and spacing effects. *Journal of Speech Language and Hearing Research*, 59(5), 1111-1122.
- Schuchard, J. & Middleton, E.L. (2018a). The roles of retrieval practice versus errorless learning in strengthening lexical access in aphasia. *Journal of Speech Language and Hearing Research*, 61(7), 1700-1717.
- Schuchard, J., & Middleton, E.L. (2018b). Word repetition and retrieval practice effects in aphasia: Evidence for use-dependent learning in lexical access. *Cognitive Neuropsychology*, 35(5-6), 271-287.

Acknowledgments

Research reported in this publication was supported by the National Institute On Deafness And Other Communication Disorders of the National Institutes of Health under Award Number R01DC015516 awarded to Erica L. Middleton. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Historical Review of Autobiographical Accounts of Aphasia

Bethan Tichborne^{1*}, and Arpita Bose¹

¹ School of Psychology and Clinical Language Sciences,
University of Reading, Reading, UK

***corresponding author, btichborne@protonmail.com**

Introduction

The subjective experience of people with aphasia provides valuable information to inform theoretical understanding of its symptoms and subtypes. For over 200 years people with aphasia have written about their experience of language impairment, and have shared these contributions with the community of researchers and clinicians working in aphasiology. At times these accounts have strongly informed the scientific literature. However, currently, despite the fact that modern autobiographical accounts of aphasia are increasing in quantity and diversity, there is little integration of these accounts with theoretical work.

To address this gap, a historical literature review was carried out to explore the number and range of autobiographical accounts of aphasia which are available. These were evaluated by era since the beginning of scientific aphasiology, with attention to the changing demographic and medical characteristics of the authors, exploration of genre and representative content of accounts in each era, and evaluation of how they were received by the scientific community and integrated with the theoretical literature (or not).

Methods

Autobiographical accounts of aphasia were identified through searches using the search term “aphasia” in combination with each of the following terms: “autobiography”, “account”, “journal”, “diary”, “first-hand”, “phenomenology” and “subjective.” Multiple searches were carried out using search engines, online library catalogues, and book selling and self-publishing platforms, between 2020 and 2023. Additional accounts were identified through references within accounts or in reviews and the wider literature. The results were grouped chronologically to explore changes and continuities in demographic and medical histories of the authors, genre and content, and the reception of these texts by the research community.

Results

Sixty-eight autobiographical accounts of aphasia meeting the inclusion criteria were identified. Figure 1 displays the distribution of these accounts over time, and by genre. The main findings are that the number and the diversity of such accounts has increased sharply over the last century and that this trend is likely to continue, and that this growth is primarily driven by the production of long form autobiography for a general audience, rather than as journal articles for a scientific community. These accounts contain insights which can make a valuable contribution to our theoretical understanding of language impairment, and have at times anticipated future scientific discoveries, but there is a lack of integration of modern autobiographical accounts with the scientific literature.

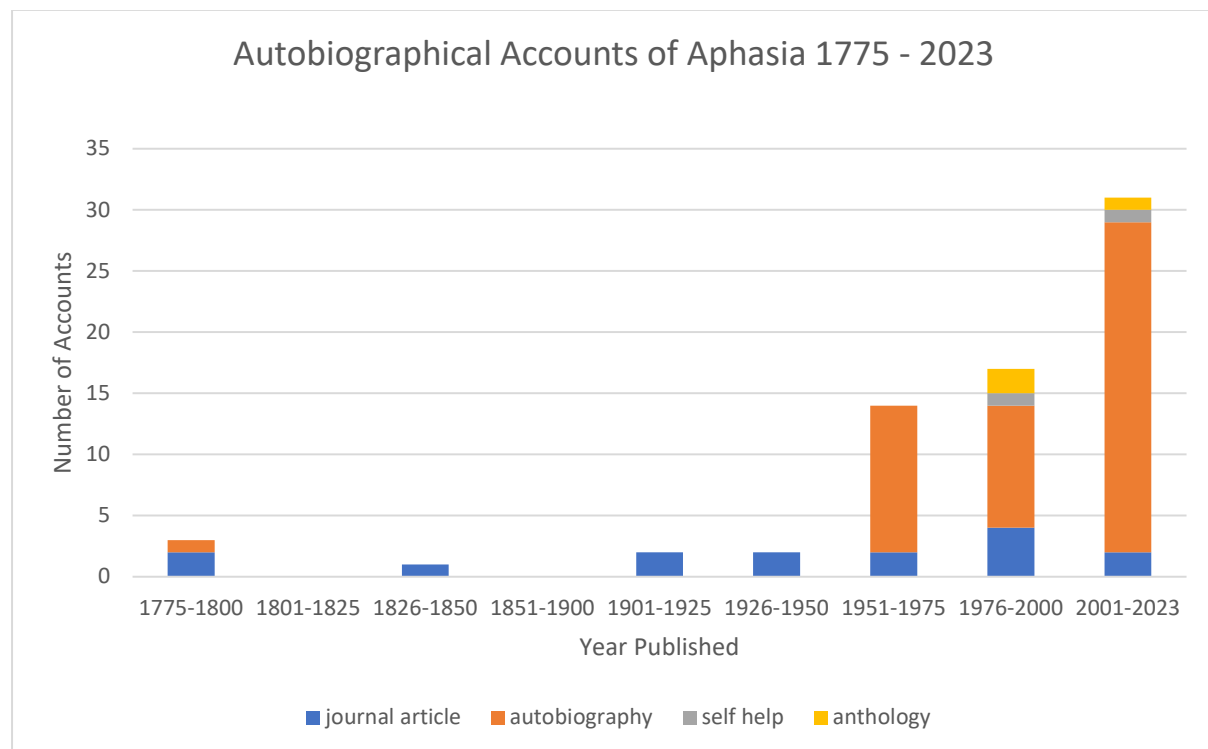
Conclusions

This review shows the value of autobiographical accounts, and the potential contribution which they can make to the wider scientific literature, and reveals the varying receptivity to these accounts within the academic community. This is a unique source of data, independently produced by people with aphasia, communicating about the topics which they consider most important. The development of methods for the capture, analysis and integration of this source of data is therefore urgently required.

Acknowledgments

PhD funding of first author provided by an ESRC South East Network for Social Sciences (SeNSS) Studentship Award.

Figure 1. Autobiographical accounts written by people with aphasia from the earliest account (1784) to the present day (2023).



Automated Lesion Segmentation Using Acute and Chronic Stroke MRI with nnU-Net

Tammar Truzman^{1*}, Matt Lambon Ralph¹, and Ajay Halai¹

¹MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge, United Kingdom

*corresponding author, truzmant@gmail.com

Introduction

Accurate lesion segmentation is critical for both clinical and research applications in stroke. Clinically, high-quality lesion maps can support the development of predictive models for post-stroke outcomes, such as language recovery (Marte et al., 2025). In research, lesion segmentation is foundational for lesion–symptom mapping and for estimating functional and structural disconnections (Bates et al., 2003; Demarco et al., 2018). Manual tracing remains the gold standard but is time-consuming, subject to inter-rater variability (DICE $\approx$ 0.73; Ito et al., 2019), and impractical for large or multi-site studies. Several automated segmentation approaches have been proposed (e.g., Pustina et al., 2016; Griffis & Pustina, 2022; Seghier et al., 2008), but performance remains moderate, especially on heterogeneous datasets (DICE $\leq$ 0.55; Ito et al., 2019).

In this study, we applied the self-configuring deep learning framework nnU-Net (Isensee et al., 2020) to large-scale, multi-site datasets of both acute and chronic stroke. We evaluated model performance across different MRI modalities and datasets from the acute and chronic phases of stroke.

Methods

We collated multi-site, open-source stroke datasets: acute (N = 1798; DWI b=1000, ADC, FLAIR; Rorden et al., 2023; ISLES, 2022; Liu et al., 2023) and chronic (N = 1171; T1-weighted only; ARC, OpenNeuro, 2023; ATLAS, 2019; CCNRP). All cases included manual lesion tracings. Separate nnU-Net models were trained for the acute and chronic datasets using default parameters. Model performance was evaluated using 5-fold cross-validation and external validation on independent datasets not included in the training sets. We tested: (1) the effect of imaging modality in acute stroke (DWI, FLAIR, and DWI+FLAIR); (2) the effect of training set size in chronic stroke (T1w); and (3) the influence of lesion characteristics (volume, laterality, MRI quality) on model performance and generalization.

Results

As hypothesized, nnU-Net achieved generalization performance approaching manual segmentation, with the best-performing models reaching Dice scores near 0.77 on unseen data. See Figure 1 for an example from the chronic models (T1-weighted MRI). Contrary to expectations, in acute stroke, DWI-only models outperformed both FLAIR-only and DWI+FLAIR models (*all* $p < .001$), indicating no added benefit from combining modalities.

In chronic stroke, increasing the training set size improved segmentation performance, though gains diminished at larger scales. Model generalization varied across datasets and was influenced by lesion volume and MRI quality (e.g., signal-to-noise ratio and tissue contrast), but not by lesion laterality.

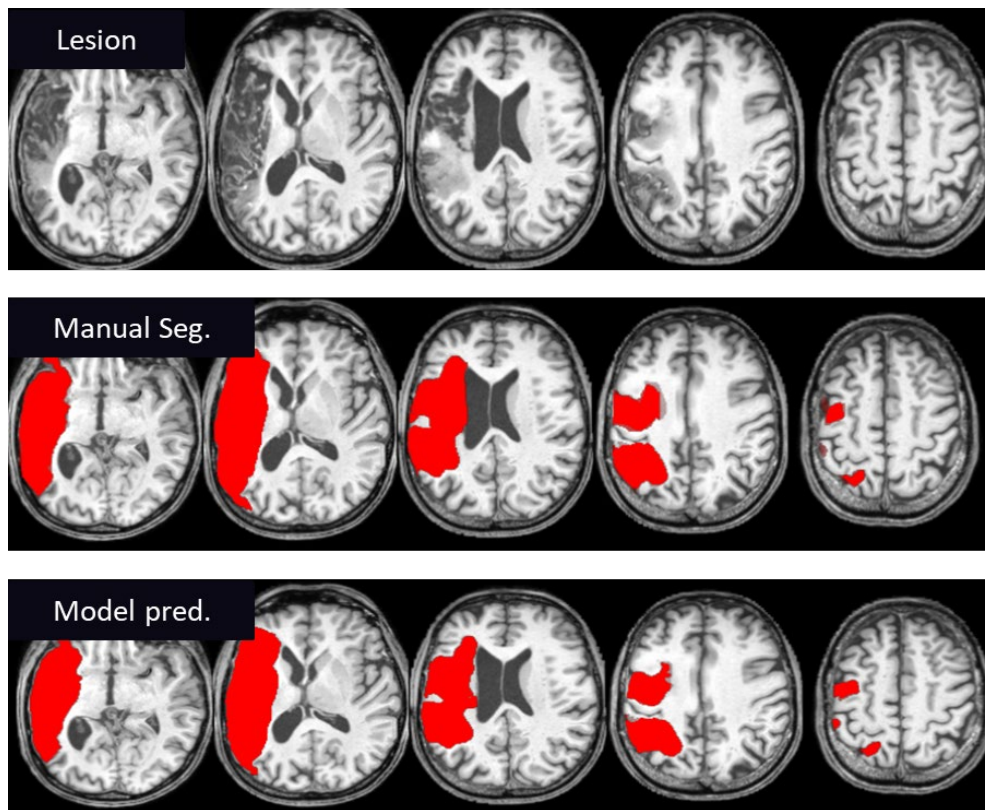
Conclusions

nnU-Net produces accurate lesion segmentations in both acute and chronic stroke, outperforming previous automated methods and nearing the reliability of manual tracing. DWI is the optimal modality for acute segmentation, and training sample size improves chronic segmentation up to a point. These findings highlight the utility of nnU-Net in large-scale research and clinical workflows. All models and code are released open source for community use and further validation.

References

- Bates, E., Wilson, S. M., Saygin, A. P., Dick, F., Sereno, M. I., Knight, R. T., & Dronkers, N. F. (2003). Voxel-based lesion–symptom mapping. *Nature Neuroscience*, 6(5), 448–450.
- DeMarco, A. T., & Turkeltaub, P. E. (2018). A multivariate lesion symptom mapping toolbox and examination of lesion-volume biases and correction methods in lesion-symptom mapping. *Human Brain Mapping*, 39(11), 4169–4182.
- Griffis, J. C., & Pustina, D. (2022). Automated lesion segmentation. In *Neuromethods* (Vol. 180, pp. 53–77).
- Isensee, F., Jaeger, P. F., Kohl, S. A. A., Petersen, J., & Maier-Hein, K. H. (2020). nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. *Nature Methods*, 18(2), 203–211.
- Ito, K. L., Kim, H., & Liew, S. L. (2019). A comparison of automated lesion segmentation approaches for chronic stroke T1-weighted MRI data. *Human Brain Mapping*, 40(16), 4669–4685.
- Marte, M. J., Carpenter, E., Scimeca, M., Russell-Meill, M., Peñaloza, C., Grasmann, U., ... & Kiran, S. (2025). Machine learning predictions of recovery in bilingual poststroke aphasia: Aligning insights with clinical evidence. *Stroke*, 56(2), 494–504.
- Pustina, D., Coslett, H. B., Turkeltaub, P. E., Tustison, N., Schwartz, M. F., & Avants, B. (2016). Automated segmentation of chronic stroke lesions using LINDA: Lesion identification with neighborhood data analysis. *Human Brain Mapping*, 37(4), 1405–1421.
- Seghier, M. L., Ramlackhansingh, A., Crinion, J., Leff, A. P., & Price, C. J. (2008). Lesion identification using unified segmentation-normalisation models and fuzzy clustering. *NeuroImage*, 41(4), 1253–1266.

Figure 1. Example of lesion segmentation from a single external validation case using the chronic T1-weighted model.



Three Japanese-speaking individuals with phonological dyslexia without phonological impairment

Shinji Uema^{1,2*}, Kosei Hashimoto³, and Akira Uno²

¹ Department of Human Sciences, Musashino University, Tokyo, Japan

² NPO Corporation LD/Dyslexia Centre, Chiba, Japan

³ Department of Speech, Language and Hearing Therapy, Mejiro University, Saitama, Japan

*corresponding author, s-uema@musashino-u.ac.jp

Introduction

Two hypotheses have been proposed regarding the mechanisms underlying phonological dyslexia: phonological impairment (Harm and Seidenberg, 2001) and sublexical reading route impairment (Coltheart et al., 2001). The presence or absence of phonological deficits is the key to understanding the mechanisms underlying phonological dyslexia. Most reported cases of phonological dyslexia involve phonological impairment. Nonetheless, a few cases without such impairment have also been documented (e.g., Caccappolo-van Vliet et al., 2004; Tree and Key, 2006; Macoir et al., 2012). To the best of our knowledge, no such cases have been reported in non-alphabetic languages to date. This study presents three cases of Japanese-speaking individuals with phonological dyslexia but preserved phonological ability. Further, we examined the mechanism underlying their nonword reading impairment.

Methods

Case A and B were men in their 40s, and Case C was a woman in her 60s. All three individuals were right-handed and exhibited aphasia resulting from a left-hemisphere stroke. They were administered the following tasks: reading of Kana strings (words and nonwords) and Kanji strings (two-character Kanji words and nonwords); reading and rapid reading of single-Kana and single-Kanji nonwords (i.e., single-character nonwords not typically used as standalone words); nonword repetition; and word and nonword repetition in reversed order.

Results

Cases A, B, and C performed within the normal range for reading Kana and Kanji words, while their scores for reading Kana and Kanji nonwords were more than 2 standard deviations (SD) below the normal average. Case A scored within the normal average in single-Kana reading, whereas Cases B and C scored more than 2 SD below the normal average. In single-Kanji nonword reading, all three individuals scored more than 2 SD below the normal average. Similarly, in rapid reading of single-Kana and single-Kanji nonwords, all three performed more than 2 SD below the normal average. In contrast, performance on the nonword repetition task and the word and nonword repetition in reversed order tasks fell within the normal range for all three cases (Table 1).

Conclusions

Cases A, B, and C exhibited phonological dyslexia in both Kana and Kanji, as their nonword reading performance was significantly poorer than their word reading performance in both writing systems. They performed comparably to the normal

subjects on the nonword and word and nonword repetition in reversed order tasks, indicating phonological dyslexia without phonological impairment. In single-Kana reading and rapid reading, Case A showed preserved single-Kana reading but poor performance in rapid reading, whereas Cases B and C performed poorly in both tasks. All three individuals performed poorly in single-Kanji nonword reading and rapid reading. These deficits in single-character and rapid reading indicate an impairment in character-to-mora conversion, contributing to nonword reading difficulties. These findings suggest that phonological dyslexia without phonological impairment can occur universally, including in non-alphabetic languages.

References

- Caccappolo-van Vliet, E., Miozzo, M., & Stern, Y. (2004). Phonological dyslexia without phonological impairment? *Cognitive Neuropsychology*, 21(8), 820-839.
- Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: a dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, 108(1), 204-256.
- Harm, M. W., & Seidenberg, M. S. (2001). Are there orthographic impairments in phonological dyslexia? *Cognitive Neuropsychology*, 18(1), 71-92.
- Macoir, J., Fossard, M., Saint-Pierre, M. C., & Auclair-Ouellet, N. (2012). Phonological or procedural dyslexia: Specific deficit of complex grapheme-to-phoneme conversion. *Journal of Neurolinguistics*, 25(3), 163-177.
- Tree, J. J., & Kay, J. (2006). Phonological dyslexia and phonological impairment: An exception to the rule? *Neuropsychologia*, 44(14), 2861-2873.

Acknowledgments

This work was supported by Japan Society for the Promotion of Science (JSPS) KAKENHI grant numbers 24K20482.

Table 1. Task performance of three cases

	case A 40s	case B 40s	case C 60s
Words reading			
Kana words (OR35) ^a			
Hiragana	30/30	30/30	30/30
Katakana	30/30	30/30	30/30
3~4 morae	40/40	40/40	40/40
Two-character Kanji words ^b	95/96	86/96	94/96
Nonwords reading			
Kana nonwords (OR37) ^a			
3 morae	14/14	11/14*	13/14*
4 morae	10/14*	11/14*	8/14*
5 morae	5/14*	8/14*	5/14*
Lexicalization error	0	1	2
Two-character Kanji nonwords ^b	45/64*	26/64*	41/64*
Lexicalization error	7	15	9
Single characters reading			
Single-Kana characters ^c	40/40	36/40*	39/40*
Single-Kanji nonwords ^d	34/40*	27/40*	27/40*
Single characters rapid reading			
Single-Kana characters ^e	17/20*	18/20*	17/20*
Single-Kanji nonwords ^f	18/20*	16/20*	11/20*
Phonological task			
Nonwords repetition(R31) ^a			
3 morae	14/14	14/14	13/14
5 morae	14/14	14/14	13/14
The word and nonword repetition in reversal order tasks (3 morae) ^g	10/12	11/12	11/12

* Indicates more than 2SD below the normal subjects' average.

^a Jochi University SALA Project Team. (2004). Sophia Analysis of Language in Aphasia.

^b Hashimoto, K., Uno, A., & Sambai, A. (2018). Development of a lexical decision task with kanji pseudo-homophones: Toward the application for aphasia assessment. *Japanese Journal of Speech, Language, and Hearing Research*, 15(4), 321-331.

^c Normal subjects (N=11, aged 40s and 60s) averaged 40.0 correct (SD:0.00).

^d Normal subjects (N=5, aged 40s) averaged 37.8 correct (SD:0.45), Normal subjects (N=6, aged 60s) averaged 37.2 correct (SD:1.20).

^e Normal subjects (N=11, aged 40s and 60s) averaged 20.0 correct (SD:0.00).

^f Normal subjects (N=5, aged 40s) averaged 19.6 correct (SD:0.55), Normal subjects (N=6, aged 60s) averaged 19.7 correct (SD:0.80)

^g Normal subjects (N=10, aged 40s) averaged 11.3 correct (SD:0.67), Normal subjects (N=10, aged 60s) averaged 11.61correct (SD:0.57).

Building a Corpus of Arabic Aphasia

Samawiyah Ulde^{1*}, Abeer AlMarridi¹, Afnan Alali¹, Ahmed Bensaid², Tariq Khwaileh¹

¹ Department of English Literature and Linguistics, Qatar University, City, Doha, Qatar

² Department of Student Data Analytics, Qatar University, City, Doha, Qatar

Introduction

Data sharing is a crucial aspect of aphasia research. Not only does it allow for in-depth analysis of the data from a range of expertise globally, it can also facilitate the creation of datasets that are large enough for use in advanced technologies like artificial intelligence. The implementation of cutting-edge technology can significantly facilitate more robust diagnosis, analysis and treatment and have direct implications for clinical use. Databases such as AphasiaBank (MacWhinney et al., 2011), MAPPD, and DELAD (Lee et al., 2023) have proven to be invaluable in this regard. While these databases are typically multilingual, there remains a pressing need for large-scale, high quality data from across the world's languages in order to maximize benefit across all populations. We hypothesized that a dedicated, language-specific database that is linked to a digitized data collection mechanism can enable not only the compilation of data at a large scale, but its systematicity can yield high quality data that is able to capture detailed, nuanced insights and enables analysis specific to the typological features of the language. The goal of this project is to build such a corpus of Arabic aphasia.

Methods

Arabic-speaking persons with aphasia are recruited by speech-language pathologists at Johns Hopkins Aramco Healthcare, Saudi Arabia. After obtaining consent, the Gulf Arabic Comprehensive Aphasia Test is administered via the digital platform SALT Labs. Audio recordings, performance reports, scoresheets, and demographic information are extracted from SALT Labs for inclusion in the database. Audio data from certain production tasks (Picture Description, Naming, Repetition and Verbal Fluency) are then manually transcribed in the Arabic script and International Phonetic Alphabet. The Picture Description transcriptions undergo further manual annotation based on adapted CHAT conventions (MacWhinney, 2000) and include the following: prosodic annotation (tone direction, stress, lengthening), error codes (phonological, semantic, neologisms, morphological, disfluencies, missing words), post codes (utterance level errors), gestures, and fillers. The data is then compiled, labelled and preprocessed for use in artificial intelligence models and uploaded to a secure, locally-hosted repository.

Results

The project will yield a rich, user-friendly Arabic corpus with audio, transcriptions, and metadata. Detailed manuals will be made publicly available. The corpus will be accessible via a secure website upon request and open for contributions of data that is collected via SALT Labs. The database will host features that enable analysis in Arabic. Finally, the data will be specifically formatted to be readily usable for AI model

training and development. The corpus is expected to significantly advance research that caters to the Arabic-speaking aphasic population.

Conclusion

Creating such a corpus establishes a foundational framework for data sharing in the digital age. This endeavor is essential for leveraging advanced AI technologies to improve the diagnosis and treatment of aphasia.

References

- Lee, A., Bessell, N., van den Heuvel, H., Klessa, K., & Saalasti, S. (2023). The DELAD initiative for sharing language resources on speech disorders. *Language Resources and Evaluation*. <https://doi.org/10.1007/s10579-023-09655-2>
- MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk*. 3rd Edition. Mahwah, NJ: Lawrence Erlbaum Associates.
- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). Aphasiabank: Methods for studying discourse. *Aphasiology*, 25(11), 1286–1307. <https://doi.org/10.1080/02687038.2011.589893>

Acknowledgments

This research is funded by the Qatar Research, Development and Innovation (QRDI) Council via the grant ARG01-0503-230065 awarded to Tariq Khwaileh.

Predictive Processing and Memory in Aphasia: Evidence from Webcam-Based Eye-Tracking

Willem S. van Boxtel*; Ally Miller; Callie Cody; Allie Folse

Louisiana State University, Baton Rouge, LA, 70802, United States

*corresponding author, wvboxtel@lsu.edu

Introduction

Sentence comprehension deficits are widespread in post-stroke aphasia. A crucial component of successful sentence comprehension is the anticipation of upcoming information using verbal cues. For instance, when hearing the word 'eat', listeners use semantic cues to predict an edible referent (e.g., 'cake'), and show increased gazes to pictures of edible compared to inedible referents (e.g., 'pencil'; Kukona, 2020). Such predictive processing has been widely studied in healthy groups using visual world eye-tracking, but has received only minor attention in persons with aphasia (PWA). Existing studies of prediction in aphasia further suffer from very low sample sizes due to in-person recruitment constraints. Additionally, prediction has been conceptualized as pre-activation of information in short-term memory, and given that aphasia is associated with memory deficits, it is unclear whether PWA can successfully leverage such pre-activation for predictive processing. This study sought to evaluate prediction and memory in PWA in a large sample using online, webcam-based eye-tracking.

Methods

This study comprised a partial replication of Mack et al. (2013). Data collection is ongoing; results reported here are from 23 PWA and 7 controls. Participants completed a visual world task in which they viewed a visual array containing four pictures and listened to sentences with the final word missing (e.g., 'Tomorrow Susan will eat the...'). Half of sentences contained a verb which semantically restricted possible verbal referents to one picture (e.g., 'eat' for the target 'cake'), while the other half contained non-restrictive verbs (e.g., 'see'). Prior to each trial, participants remembered three words which were either semantically related (interfering) or unrelated (non-interfering) to the target word to manipulate memory demands (e.g., for 'cake', interfering words were 'candle', 'birthday', 'icing'). Participants were prompted to recall these words after a random 50% of trials to ensure attentiveness. We hypothesized faster, more accurate responses in restrictive compared to non-restrictive trials, and interfering word sets were hypothesized to lead to slow-downs and accuracy reductions in PWA. Eye movements were recorded during the task using WebGazer.js, which predicts gaze locations on the screen through participants' webcams. We predicted higher proportions of gazes to the target picture in restrictive v. unrestrictive trials.

Results & Conclusions

Both PWA and controls were more accurate and faster to respond when verbs were restrictive compared to unrestrictive ($ps < .001$). PWA showed smaller, yet reliable, differences between verb types ($ps < .001$), indicating intact predictive processing. Eye movement analyses suggest higher proportions of gazes to the target picture in a critical time window between 6000 and 9000ms post-onset (see Figure), further indicating successful prediction. Formal analysis of eye movement data is ongoing.

Memory interference did not reliably affect any outcome metric (all $ps > .05$), suggesting that PWA successfully predict upcoming words despite memory deficits (PWA were significantly less accurate than controls on the included recall prompts). Overall, these results make the case for further studies of prediction in aphasia, including efforts to develop prediction-based assessments for sentence comprehension. Finally, the successful use of webcam-based eye-tracking in this study confirms the applicability of this method to communication disorders research at large.

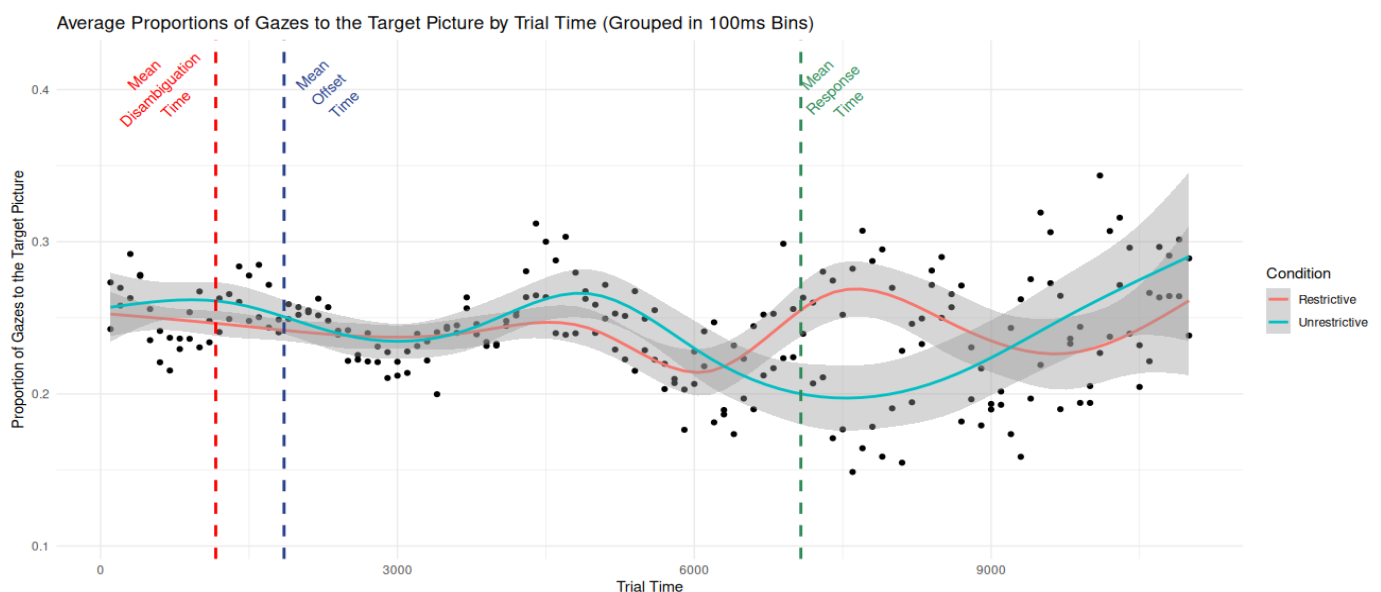
References

- Kukona, A. (2020). Lexical constraints on the prediction of form: Insights from the visual world paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46(11), 2153.
- Mack, J. E., Ji, W., & Thompson, C. K. (2013). Effects of verb meaning on lexical integration in agrammatic aphasia: Evidence from eyetracking. *Journal of Neurolinguistics*, 26(6), 619-636.

Acknowledgments

This research was funded by the American Speech-Language-Hearing Foundation (New Investigators Research Grant awarded to WvB).

Figure



Unraveling sentence complexity in Primary Progressive Aphasia: how number dissimilarity and phonological cues modulate the comprehension of subject and object relatives in French

Mauro Viganò^{1*}, Marc Teichmann², and Carlo Cecchetto^{1,3}

¹ UMR7023 Structures Formelles du Langage, CNRS & Université Paris 8, Paris, France

² Department of Neurology, Reference Center for ‘Rare or Early Onset Dementias’, *Institut de la Mémoire et de la Maladie d’Alzheimer*, DMU Neurosciences, Pitié Salpêtrière University Hospital, Assistance Publique – Hôpitaux de Paris (APHP), Paris, France.

³ Department of Psychology, Università degli Studi di Milano-Bicocca, Milan, Italy

*corresponding author, dott.mauro.vigano@gmail.com

Introduction

The asymmetry in the comprehension of subject relatives (1) and object relatives (2) is a well-documented phenomenon in people with aphasia (Adelt et al., 2017). One possible explanation relies on the syntactic notion of minimality effect, which suggests that object relatives are more challenging to process across languages, including French, due to a potential structural interference of the subject, underlined in (2) (Grillo, 2008). Morphosyntactic dissimilarities between the head of the relative and the subject could reduce the minimality effect and facilitate comprehension, (3). A key objection is that overt morphology provides a superficial cue for meaning extraction without full syntactic processing (Terzi & Nanousi, 2018).

- (1) Montrez-moi **le magicien**_i qui **t_i** suit le chef
“Show me the magician that chases the cook”
- (2) Montrez-moi **le magicien**_i que le chef suit **t_i**
“Show me the magician that the cook chases”
- (3) Montrez-moi **le magicien**_i que les chefs suivent **t_i**
“Show me the magician that the cooks chase”

French provides an ideal testing ground because number feature is active in subject-verb agreement but not always phonologically marked. For example, the difference between singular and plural is audible in *suivre* (“to chase”, /syi/ vs. /syiv/) but not in *pousser* (“to push”, singular=plural: /pus/).

This preliminary study investigates the comprehension of relatives in French across the three variants of Primary Progressive Aphasia (nonfluent/agrammatic: nfvPPA, logopenic: lvPPA, semantic: svPPA). In particular, it tests the effect of three factors:

- *type of relative*: subject vs. object;
- *number dissimilarity*: present vs. absent;
- *audibility of number dissimilarity*: audible vs. non-audible.

Methods

We included 13 native French-speaking patients with PPA (nfvPPA: N=3; lvPPA: N=3; svPPA: N=7) diagnosed according to the international clinical and imaging criteria (Gorno-Tempini et al., 2011) and 30 healthy controls. Exclusion criteria were MMSE<15/30 and BREF<10/18 (Folstein et al., 1975; Dubois et al., 2000). Auditory

comprehension of subject and object relatives was assessed using a sentence-to-picture matching task (Friedmann et al., 2009; *Figure 1*), considering the three factors (2x2x2 design, 6 items per condition + 24 control sentences = 72 items). Given the small sample size, accuracy rates were analyzed with descriptive statistics and Cohen's *h* for effect size.

Results

Accuracy was lower with object relatives than with subject relatives in nvPPA and lvPPA. Patients with svPPA performed at ceiling across conditions. The presence of number dissimilarity in object relatives emerged as a facilitation factor in lvPPA and nvPPA. No effect was found for the audibility factor (detailed results in *Table 1*). In healthy controls, performance reached near-ceiling levels (data not reported).

Conclusions

Our preliminary results support that number dissimilarity facilitates the comprehension of object relatives at an abstract syntactic level, regardless of phonological information. This corroborates a syntactic explanation in terms of minimality effect over a cue-based account of sentence disambiguation in terms of overt morphology. The study also contributes to our understanding of syntactic impairments in PPA, suggesting their relevance in both nvPPA and lvPPA, while highlighting the importance of considering morphosyntactic features in language assessment.

References

- Adelt, A., Stadie, N., Lassotta, R., Adani, F., & Burchert, F. (2017). Feature dissimilarities in the processing of German relative clauses in aphasia. *Journal of neurolinguistics*, 44, 17-37.
- Dubois, B., Slachevsky, A., Litvan, I., & Pillon, B. F. A. B. (2000). The FAB: a frontal assessment battery at bedside. *Neurology*, 55(11), 1621-1626.
- Friedmann, N., Belletti, A., & Rizzi, L. (2009). Relativized relatives: Types of intervention in the acquisition of A-bar dependencies. *Lingua*, 119(1), 67-88.
- Gorno-Tempini, M. L., Hillis, A. E., Weintraub, S.,... & Grossman, M. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006-1014.
- Grillo, N. (2008). *Generalized minimality*. Utrecht Institute of Linguistics, OTS.
- Folstein, M., Folstein, S., & McHugh, P. R. (1975). Mini-Mental state: a practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12, 189-198.
- Terzi, A., & Nanousi, V. (2018). Intervention effects in the relative clauses of agrammatics: The role of gender and case. *Glossa*, 3(1).

Acknowledgments

The authors thank the teams of the French Reference Center for 'Rare or Early Onset Dementias' and of the *Institut de la Mémoire et de la Maladie d'Alzheimer* for their collaboration, and the students of the *Université Paris 8* who contributed to the recruitment of the control sample. The present submission is intended for presentation in an online poster session.

Figure 1. Example of picture stimulus.



Table 1. Summary of the results.

Type of sentence	lvPPA	nfvPPA	svPPA
Subject Relatives	92% (8)	92% (4)	96% (4)
Object Relatives	29% (29)	54% (29)	93% (10)
Δ SR-OR [Cohen's <i>h</i>]	63% [1.415]**	38% [0.902]**	4% [0.161]
OR no mismatch	19% (13)	36% (41)	90% (9)
OR with mismatch	39% (47)	72% (21)	95% (13)
Δ ± mismatch [Cohen's <i>h</i>]	19% [0.433]*	36% [0.742]**	5% [0.187]
OR non audible contrast	39% (54)	67% (29)	98% (6)
OR audible contrast	39% (42)	78% (19)	93% (19)
Δ ± audibility [Cohen's <i>h</i>]	0% [0]	11% [0.249]	-5% [-0.231]

Notes. Results are reported as proportion of correct responses: mean (standard deviation). Cohen's *h* interpretation: *=medium effect size; **=large effect size. SR: Subject Relatives; OR: Object Relatives; lvPPA: logopenic variant of Primary Progressive Aphasia (PPA); nfvPPA: nonfluent/agrammatic variant of PPA; svPPA: semantic variant of PPA.

Language impairment profile of a polyglot following neurosurgical resection: a case report

Catherine Wang^{1*}, Ilina Bhaya-Grossman², Jill Kries³, Edward Chang¹

¹ Department of Neurological Surgery, University of California, San Francisco, San Francisco, California, USA

² University of California, Berkeley–University of California, San Francisco Graduate Program in Bioengineering, Berkeley, California, USA

³ Department of Psychology, Stanford University, Stanford, California, USA

***corresponding author, catherine.wang2@ucsf.edu**

Introduction

In highly multilingual individuals, what factors predict language specific impairments following neurosurgical resection? In multilinguals, one's native language is more resistant to impairment post-stroke (Kuzmina et al., 2019). This may be due to differential language activation, where native languages activate and perhaps require a smaller cortical area relative to other known languages (Perani & Abutalebi, 2005; Malik-Moraleda et al., 2024). In healthy and impaired bilinguals, cognate facilitation during picture naming also reveals differential performance between native and other known languages (Rosselli et al., 2012; Marte et al., 2023).

Here, in a highly multilingual individual who underwent brain tumor resection, we find native language resilience evidenced by spared native language skills in contrast to deficits in other languages. Using cognates, we show the individual's native language supports lexical retrieval in other known languages.

Methods

The patient is a 55 year-old left-handed female with no prior history of neurological impairment. English is her native language (L1), with varying proficiency in German, French, Spanish, Italian, Afrikaans, and Mandarin (L2-L7, most to least proficient). She learned all languages except English and Afrikaans in late adolescence and adulthood. The patient presented with several months of auditory processing difficulty and an episode of aphasia, then underwent an awake craniotomy for resection of a left temporal glioblastoma.

Speech and language testing was completed at 6 time points before and after surgery, using the Quick Aphasia Battery (English), Bilingual Aphasia Test (German, French), and nonstandard tasks (German, French). Structural brain imaging was collected before and after resection. The patient also provided detailed subjective reports of her language deficits.

Results

The patient demonstrated mildly impaired word retrieval in L1 (English) in the immediate postoperative period, which improved to within normal limits by 1 month post-surgery. In contrast, in L2-L3 for which she was previously highly proficient, she showed persistent impairments in lexical retrieval, measured by picture naming (Table 1). L4-L7 were not assessed due to her self-report of very poor postoperative proficiency. Notably, retrieval accuracy of cognates in L2-L3 shared with L1 was higher than that of non-cognates. This pattern was observed at 1 week and 7 months post-surgery. The patient performed within normal limits on a cognitive battery in English.

Conclusions

This case report suggests that native language status influences recovery outcomes, observed by dissociable impairment patterns in L1-L7 in a highly multilingual individual; her L1 deficits largely improved post-surgery while lexical retrieval deficits in L2-L7 persisted. Differences in cognate versus non-cognate retrieval in L2-L3 suggest that the resilience of L1 lexical forms supports word finding in other known languages. These results support an interactive account of language-specific lexicons, where L2+ retrieval is mediated by L1.

L1 resilience aligns with prior findings that the native language holds a privileged status in language processing and is less vulnerable to impairment in brain tumor cohorts (Alimohamadi et al., 2023). To our knowledge, this study is the first to show that L1 can support lexical retrieval in other known languages following brain tumor resection in a highly multilingual individual.

References

- Alimohamadi, M., Pour-Rashidi, A., Digaleh, H., Zibadi, H. A., Hendi, K., Raminfar, S., Rahmani, M., Larijani, A., Shirani, M. (2023). Disparity of primary and secondary language outcomes in bilingual patients undergoing resection of glioma of the speech-related regions. *Word Neurosurgery*, 176, e327-e336. doi: 10.1016/j.wneu.2023.05.057
- Kuzmina, E., Goral, M., Norvik, M., Weekes, B. S. (2019). What influences language impairment in bilingual aphasia? A meta-analytic review. *Frontiers in Psychology*, 10, 445. doi: 10.3389/fpsyg.2019.00445
- Malik-Moraleda, S., Jouravlev, O., Taliaferro, M., Mineroff, Z., Cucu, T., Mahowald, K., Blank, I. A., Fedorenko, E. (2024). Functional characterization of the language network of polyglots and hyperpolyglots with precision fMRI. *Cerebral Cortex*, 34(3), bhae049. doi: 10.1093/cercor/bhae049
- Marte, M. J., Peñaloza, C., Kiran, S. (2023). The cognate facilitation effect on lexical access in bilingual aphasia: Evidence from the Boston Naming Test. *Bilingualism: Language and Cognition*, 26(5), 1009-1025. doi: 10.1017/s1366728923000251
- Perani, D. & Abutalebi, J. (2005). The neural basis of first and second language processing. *Current Opinion in Neurobiology*, 15(2), 202–206. doi: 10.1016/j.conb.2005.03.007
- Rosselli, M., Ardila, A., Jurado, M. B., Salvatierra, J. L. (2012). Cognate facilitation effect in balanced and non-balanced Spanish–English bilinguals using the Boston Naming Test. *International Journal of Bilingualism*, 18(6), 649-662. doi: 10.1177/1367006912466313

Acknowledgments

We would like to thank the patient and her caregivers for their participation and dedication in contributing to this project, as well as the patient's neurosurgical and neuro-oncological care teams at UCSF.

Figure 1. MRI imaging of the patient’s tumor and resection. A: Pre-operative T2 FLAIR imaging showing a 2.9 x 2.1 cm rim-enhancing tumor in the left temporal lobe, B: 1 day postoperative T2 FLAIR imaging showing gross total resection of the tumor.

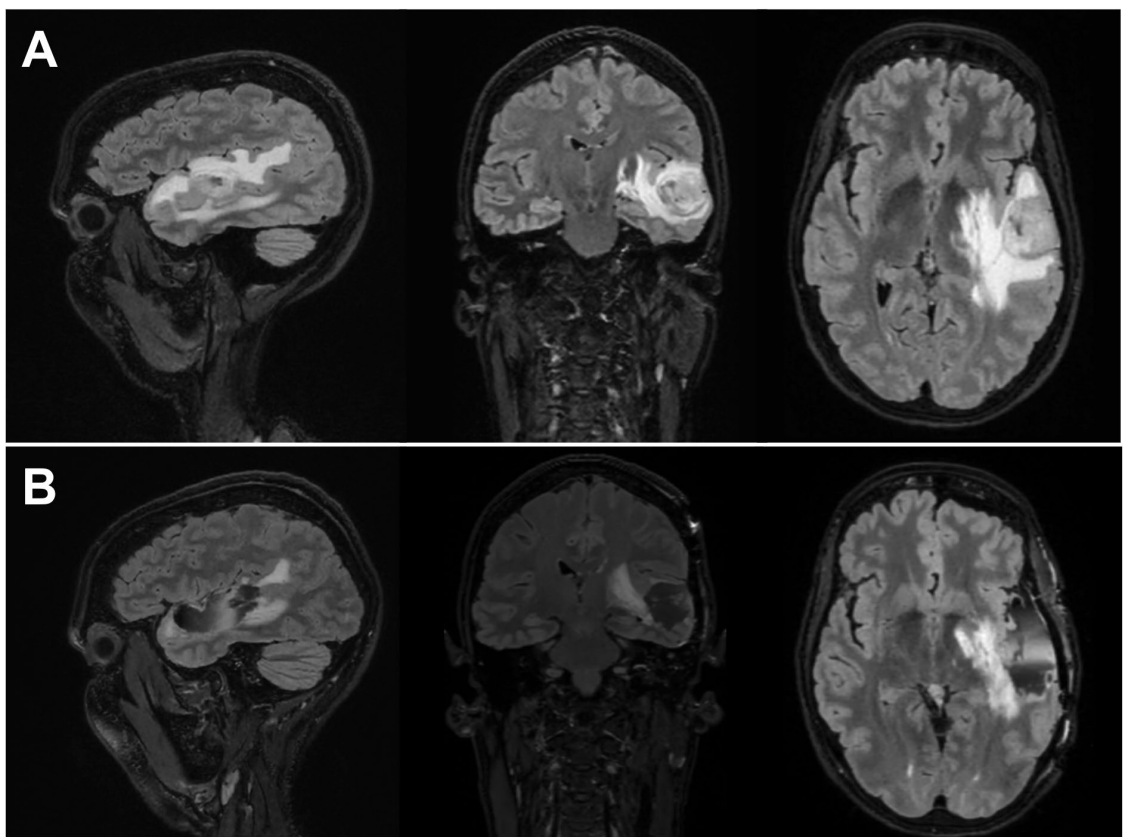


Table 1. Patient’s performance on picture naming across L1 (English) and her two highest-proficiency L2s (German, French). Performance was assessed at 1 week and 7 months post-surgery using the same stimuli. Stimuli, which were consistent across languages, included items from the Naming section of the Bilingual Aphasia Test and additional cognate items. “L1 cognates” are items in each language that are shared with L1. “L2 cognates” are items in each language that are shared with another L2 but *not* shared with L1. Performance is shown as percentage accurate within each category; total number of items varied across categories.

Language	% Accuracy, 1 week post-surgery			% Accuracy, 7 months post-surgery		
	L1 cognates	L2 cognates	Non-cognates	L1 cognates	L2 cognates	Non-cognates
English		100	100		100	100
German	60	50	23	67	40	35
French	80	40	20	50	56	25

Cerebral Reorganization in Post-Stroke Anomia: An fNIRS pilot study

Meng Huan Wang¹, Wei Wei Dou², Jing Gao³, and Dan Dan Liang^{1*}

¹ School of Chinese Language and Culture, Nanjing Normal University, Nanjing, (Jiangsu), China

² School of Foreign Languages and Cultures, Nanjing Normal University Zhongbei College, Danyang (Jiangsu), China

³ Sir RunRun Hospital Affiliated Nanjing Medical University, Nanjing, (Jiangsu), China

***Corresponding author, 03275@njnu.edu.cn**

Introduction

Post-stroke aphasia impairs multiple language domains—phonetics, morphology, semantics, syntax, and pragmatics—and often manifests as anomia, the difficulty or inability to retrieve words, which represents one of the most pervasive and disabling deficits across all aphasia subtypes (Fridriksson et al., 2009; Macoir & Lavoie, 2021). Even in its mildest form, anomia can profoundly disrupt daily functioning, precipitating loss of employment, social isolation, depressive symptoms, and diminished quality of life (Sheppard & Sebastian, 2021). Despite extensive research on left-hemisphere language networks, the contribution of right-hemisphere structures to post-stroke reorganization and recovery remains poorly understood. In this pilot study, we applied graph-theoretical network analysis to explore the neural mechanisms that support recovery from anomia following stroke.

Methods

We recruited 16 subacute post-stroke anomia (PSA) patients and 16 age- and sex-matched healthy controls (HC). All participants completed a baseline picture-naming task under fNIRS recording. PSA patients then underwent 15 treatment sessions, after which they repeated the picture-naming fNIRS assessment. Behavioral performance was quantified by naming accuracy (ACC) and Western Aphasia Battery (WAB) scores. We applied network-based statistics (NBS) to (1) identify the pathological network between PSA and HC at baseline and (2) delineate the recovery network in PSA following treatment. Finally, we computed nodal centrality measures (degree and betweenness) and evaluated their longitudinal changes via generalized estimating equations.

Results

The pathological network in PSA was characterized by predominantly left-hemispheric hubs, including the dorsolateral prefrontal cortex (DLPFC), orbital inferior frontal gyrus (IFG_{orb}), Broca's area, and supramarginal gyrus (SMG). In contrast, the post-treatment recovery network featured strengthened connections among the right IFG_{orb}, the right-hemisphere homolog of Broca's area, the left frontopolar area (FPA), the left premotor and supplementary motor area (pSMA), and the left SMG. Regarding nodal metrics, healthy controls exhibited significantly higher degree centrality in the left IFG_{orb} ($P = 0.004$) and higher betweenness centrality in the right SMG ($P < 0.001$) compared to PSA patients at baseline. Notably, PSA patients at baseline showed elevated betweenness centrality in the Broca homologous region relative to both controls ($P = 0.012$) and their own post-treatment values ($P < 0.001$). Moreover, greater reductions in betweenness centrality within the Broca homologue from

baseline to post-treatment were strongly associated with improvements in aphasia severity (WAB–AQ; $r = -0.71$, $P = 0.002$) and subscale scores for spontaneous speech, repetition, and naming/word finding.

Conclusions

The findings indicate that language deficits in subacute PSA patients might stem from functional suppression within the classic left-hemisphere language network, notably Broca's area and the supramarginal gyrus. Following treatment, increased interhemispheric functional connectivity coupled with a reduction in betweenness centrality of the right-hemisphere Broca homologue correlated with language gains, illustrating a dynamic pattern of cortical reorganization during aphasia rehabilitation.

References

- Fridriksson, J., Baker, J. M., & Moser, D. (2009). Cortical mapping of naming errors in aphasia. *Human Brain Mapping*, 30(8), 2487–2498.
- Macoir, J., & Lavoie, M. (2021). Definitions: Anomia. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior*, 144, 212.
- Sheppard, S. M., & Sebastian, R. (2021). Diagnosing and managing post-stroke aphasia. *Expert Review of Neurotherapeutics*, 21(2), 221–234.

Acknowledgments

This study was supported by the National Key Research & Development Program of China (No. 2022YFC2009700). We thank all participants for their contribution to this work.

Figure 1. Pathological and recovery networks identified by NBS

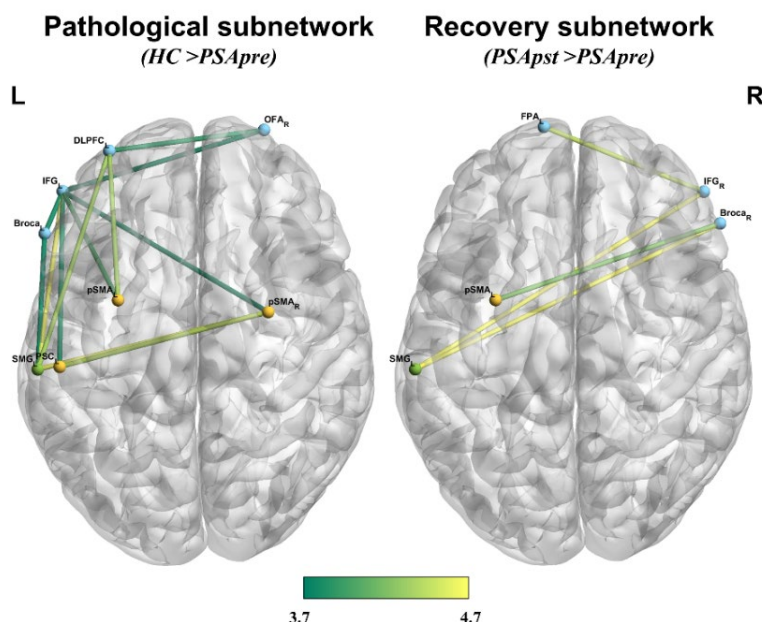


Table 1. The demographic data for participants

	People with anomia N=16 (SD)	Health control N=16 (SD)	t/Z/ χ^2	P
Age (years)	45.00 (14.00)	45.00 (12.98)	0	>0.99
Gender (n)				
<i>Male</i>	6	6	/	>0.99
<i>Female</i>	10	10	/	
Education (years)	10.94 (3.34)	11.31 (3.26)	122.5	0.848
Disease type (n)				
<i>Hemorrhage</i>	11	/	/	/
<i>Ischemia</i>	5	/	/	/
Onset time (month)	3.63 (2.81)	/	/	/
Aphasia type (n)				
<i>Anomic Aphasia</i>	8	/	/	/
<i>Broca's Aphasia</i>	8	/	/	/

Regional Atrophy Patterns in Post Stroke Aphasia: A Voxel-Based Morphometry Study

Qingchun Wang^{1*}, Fang Wang², Yang Liu³, Lu Yu², Tian Jiang¹, Yongkun Guo⁴, Jiajun Zhang³, Yuan Lyu⁵, Xinjun Wang⁵, Wai-Ting Siok¹

¹Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hong Kong SAR, PR China

²Department of Rehabilitation Medicine, The Fifth Affiliated Hospital of Zhengzhou University, Zhengzhou, China

³Department of Medical Imaging, The Fifth Affiliated Hospital of Zhengzhou University, Zhengzhou, China

⁴Department of Neurology, The Fifth Affiliated Hospital of Zhengzhou University, Zhengzhou, China

⁵ Department of Clinical Research and Translational Medicine, The Third Affiliated Hospital of Zhengzhou University, Zhengzhou, China

***corresponding author, wtsiok@polyu.edu.hk, (W.T. Siok)**

Introduction

The neuroanatomical structure of the brain is a key biomarker for the study of acquired language disorders. Previous studies have identified multiple brain regions showing significant differences between aphasic patients and healthy participants (Hartwigsen & Saur, 2019). However, the regional atrophy patterns cross different linguistic systems remain unclear.

Methods

In this study, we used structural MRIs to detect changes in grey matter (GM) volumes of patients with language deficits. We recruited ten stroke survivors who exhibited language impairments resulting from unilateral left-hemisphere lesions from a local hospital in mainland China. Patients' language performances were evaluated by an experienced speech pathologist using the *Chinese Rehabilitation Research Center Aphasia Examination* (CRRCAE; Zhang et al., 2005), a widely adopted aphasia battery in mainland China. Neuroimaging examinations were performed on a 3.0T Phillip Ingenia scanner. The neuroanatomical features of the brain were carefully examined by adopting Voxel-Based Morphometry (VBM; Ashburner & Friston, 2000). Ten healthy participants matched for gender, age, language background and education level served as the control group.

Results

Behavioral results from the CRRCAE revealed significant language deficits in tested linguistic domains including speech comprehension, speech production, reading comprehension, writing, repetition and read aloud. VBM analyses have identified several regional atrophy patterns in the aphasic group. In line with the classic language processing theory, we found major decreased GM volumes in the left inferior frontal gyrus which is hypothesized to respond to language production ($k = 885$, suprathreshold voxels; voxel peaks: $x = -39$, $y = -31.5$, $z = -12$). We also observed an expanded cluster located in the left middle temporal gyrus which is involved in semantic processing ($k = 943$, suprathreshold voxels; voxel peaks: $x = -51$, $y = 4.5$, $z = -22.5$). Notably, VBM analyses revealed significant tissue reductions in the left

middle frontal gyrus (LMFG) at Brodmann area 9 ($k = 543$, suprathreshold voxels; voxel peaks: $x = -12$, $y = 33$, $z = 30$) which is proposed to be a unique brain region involved in Chinese reading, a logographic writing system which relies heavily on the convention of orthography to semantics. Previous studies have suggested that the dysfunction of the LMFG was associated with Chinese reading difficulty (Siok et al., 2004). As for the right hemisphere, significantly reduced cortical volumes were found in the hippocampus ($k = 723$, suprathreshold voxels; voxel peaks: $x = 42$, $y = -19.5$, $z = -13.5$) and insula ($k = 562$, suprathreshold voxels; voxel peaks: $x = 31.5$, $y = 25.5$, $z = -6$), possibly affecting language related functions such as working memory.

Conclusions

The present study examined the regional differences in cortical volume between aphasic patients and healthy controls. The reported results revealed a unique pattern of regional atrophy in Chinese aphasic group. Our findings support potential involvements of the LMFG in processing logographic language system by emphasizing significant decreases in GM volumes.

References

- Ashburner, J., & Friston, K. J. (2000). Voxel-based morphometry-the methods. *Neuroimage*, 11(6), 805-821.
- Hartwigsen, G., & Saur, D. (2019). Neuroimaging of stroke recovery from aphasia—Insights into plasticity of the human language network. *Neuroimage*, 190, 14-31.
- Siok, W. T., Perfetti, C. A., Jin, Z., & Tan, L. H. (2004). Biological abnormality of impaired reading is constrained by culture. *Nature*, 431(7004), 71-76.
- Zhang, Q., Ji, S., Li, S., He, Y., Jia, G., Qin, J., & Tian, H. (2005). Reliability and validity of Chinese rehabilitation research center standard aphasia examination. *Chinese journal of rehabilitation theory and practice*, 703-705.

Acknowledgments

Funding was provided by a Henan Province Science and Technology Research Project. We thank Y. Lin for support throughout the course of this work. This submission is NOT part of a symposium or workshop.

Table 1. MNI coordinates of the regions with significant reductions in GM volume

Brain region	Cluster size, (in voxels)	Peak MNI coordinates		
		x	y	z
Middle temporal gyrus_L	943	-51	4.5	-22.5
Inferior frontal gyrus_L	885	-39	-31.5	-12
Middle frontal gyrus_L	543	-12	33	30
Hippocampus_R	723	42	-19.5	-13.5
Insula_R	562	31.5	25.5	-6

Speech-language treatment for non-progressive aphasia in people who speak tone languages

Guanyu Wei¹

¹ Department of Psychological Sciences, Case Western Reserve University,
Cleveland, Ohio, United States

*corresponding author, wei.guanyu@outlook.com

Introduction

Tone in Languages

Tone is essential in many languages, influencing morpheme meanings through pitch variations (Hyman, 2006; Yip, 2002). In non-tone languages like English, tone changes express emotional nuances, such as uncertainty with a rising tone. In tone languages like Mandarin, pitch variations convey different meanings for the same morpheme (Li et al., 2006). Examples include Cantonese, Vietnamese, Thai, Meitei, Lao, and Hmong. In Standard Chinese, the syllable "ba" can mean "eight" [bā], "pull" [bá], "target" [bǎ], or "father" [bà] depending on the tone.

Aphasia-related disorders affecting tone production and reception can severely impact communication for tone language speakers. Addressing tone is crucial for aphasia patients speaking tone languages due to its semantic significance (Chen et al., 2022).

Treatment for Aphasia

Although most aphasia research focuses on English, 60–70% of global languages are tonal (Yip, 2002). In the US, around 40,000 native Chinese speakers suffer from post-stroke language disorders, including aphasia (Pak-Hin Kong, 2011). English-focused aphasia research often overlooks tonal impacts, offering limited guidance for assessing and treating aphasia in tone languages. Mandarin-speaking aphasia patients show lower tone production accuracy, especially with apraxia of speech (Chen et al., 2022).

Many tone languages are spoken in regions lacking developed speech-language pathology fields, such as mainland China and Vietnam (Lee et al., 2024; Wei et al., 2024). Understanding research evidence on treatments for other languages is essential for advancing the field and guiding future research. This presentation summarizes current evidence on speech-language-pathology-based treatment for tone language-speaking aphasia patients.

Methods

A literature search was conducted in April 2024 using databases like MEDLINE, CINAHL, PsycINFO, and PubMed. Search terms combined "aphasia" with related keywords. Tone language names were included to enhance the search's comprehensiveness. Tone languages with over 45 million speakers, such as Mandarin, Panjabi, Vietnamese, Cantonese, and Thai, were included.

Results

The search yielded 878 articles for title and abstract review, with 22 qualifying for full-text screening, and six included in the review. Effective treatments for tone language-speaking aphasia patients included modified melodic intonation therapy (MIT) (Chen et al., 2023; Zhang et al., 2021), semantic feature analysis (SFA) (Li & Kiran, 2021), verb network strengthening treatment (VNeST) (Li et al., 2021), idiom-based treatment (Pei et al., 2023), and visual-based naming activity (Yeung & Law, 2010). Five studies

involved non-fluent aphasia participants, and one study did not specify aphasia type (Li & Kiran, 2021). Mandarin was examined in five studies, and Cantonese in one (Yeung & Law, 2010).

The effectiveness of VNeST and SFA (Li & Kiran, 2021; Li et al., 2021) suggests that treatments designed for English speakers may benefit tone language speakers. Success with MIT tailored to tonal features indicates that adapting existing treatments linguistically and culturally could aid researchers and clinicians working with tone language-speaking patients.

Conclusions

Effective treatments for English-speaking aphasia patients should be adapted and explored for tone language speakers. Including tone languages in aphasia treatment can reduce health disparities globally.

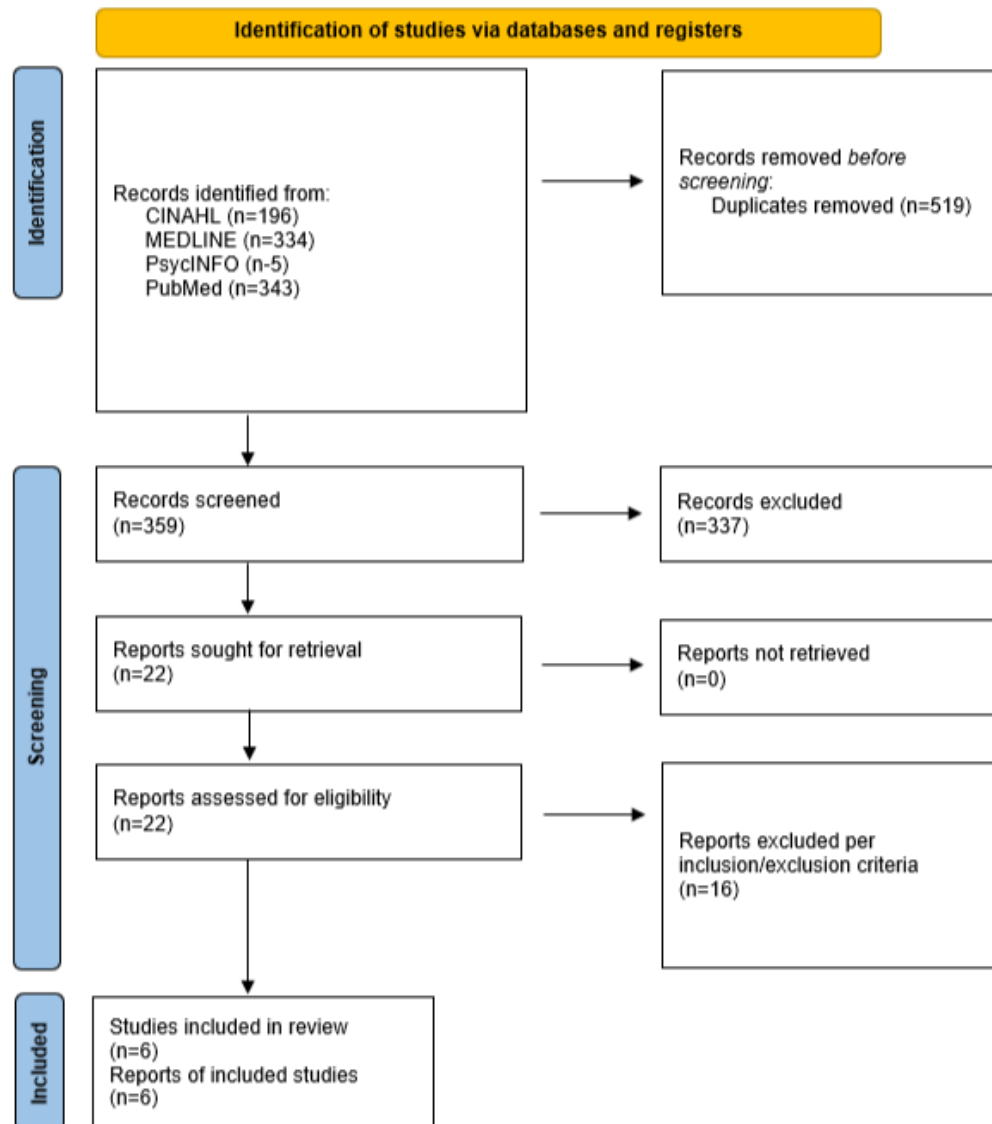
References

- Chen, W., van de Weijer, J., Qian, Q., Zhu, S., & Wang, M. (2022). Tone and vowel disruptions in Mandarin aphasia and apraxia of speech. *Clinical Linguistics & Phonetics*, 37(8), 742–765. <https://doi.org/10.1080/02699206.2022.2081611>
- Hyman, L. M. (2006). Word-prosodic typology. *Phonology*, 23(2), 225–257. <https://doi.org/10.1017/S0952675706000893>
- Lee, S. A. S., Ang, C. H. M., Chafcouloff, E., Choi, S. H., Chua, K. W. D., Cuadro, C. K., Hassan, F. H., Kariyasu, M., Lertsukprasert, K., Sasheendran, S., Supiaty, U., Tsai, M.-J., Tseng, S.-C., Wang, R., Wong, M. N., & Yuan, S. (2024). Speech-language pathology and audiology professions in Asia: Past history and current status. *Perspectives of the ASHA Special Interest Groups*. https://doi.org/10.1044/2024_PERSP-24-00039
- Li, P., Tan, L. H., Bates, E., & Tzeng, O. J. L. (Eds.). (2006). *The handbook of East Asian psycholinguistics, Volume 1: Chinese*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511550751>
- Pak-Hin Kong, A. (2011). Aphasia assessment in Chinese speakers. *The ASHA Leader*, 16(13). <https://doi.org/10.1044/leader.FTR8.16132011.36>
- Wei, G., Yuan, A., Tian, R., & Liu, K. (2024). Speech-language pathology in China – An overview. *Perspectives of ASHA Special Interest Groups*, 9(3), 877-882. https://doi.org/10.1044/2024_PERSP-23-00160
- Yip, M. (2002). *Tone*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9781139164559>

Acknowledgments

The content of this proposal is currently submitted to a journal as a manuscript and is in review. The author would like to thank Lauren Calandruccio, Angela Ciccio, Monica Gordon Pershey, and Alayna Rowell for their time and efforts in reviewing the content of the original manuscript. Additionally, the author is grateful to Grace Capretta, Cassandra Lopez, and Jean Nisenbom for proofreading and editing the original manuscript.

Figure 1. Prisma Flowchart.



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

Table 1. Data Collection Sheet

Article	Language	Type of aphasia	Other Demographic -N -Gender (male:female) -Age at the time of study: -M(SD) -Age range -Time post-aphasia(days): M(SD)*	Treatment approach/method discussed	Significant Results**	Implications
Chen et al., 2023	Mandarin Monolingual	Non-fluent aphasia, characterized by <i>“Moderately preserved language comprehension, non-fluent and restricted oral production, sometimes limited meaningless stereotypes, and poor repetition of words or phrases.”</i>	- 6 - 3:3 - 48.67 (14.46) - 26-67 - 325 (94)	Modified melodic intonation therapy based on prosodic characteristics: 50-minute sessions (with the first 15 minutes focusing on tone only) for 6 weeks, 5 times a week. Session delivered in person by experienced therapists. Music notes were abandoned from this adaptation. Instead, this adaptation fully accounts for the features of Mandarin Chinese as a tone and syllable-timed language by setting up rules to improve the realization of lexical tones.	BDAE scores ($p<0.05$): Articulation - mean +33.75; median +30.00 Recitation & music - mean +35.42; median +30.00 Repetition - mean +23.33; median + 22.50 Naming - mean +11.10; median +18.35 FACS scores ($p<0.05$): mean +1.00; median +0.33	Authors reported that the improvement in BDAE scores, FACS scores, and qualitative improvement of communication skills on a case-by-case basis proved the feasibility of this tone--rhythmic training.
Li & Kiran, 2021	Mandarin English Bilingual	NR	- 12 - 6:6 - 52.6 (18.5) - 25.2-75.2 - 1542 (1452)	Semantic feature analysis (focusing on verb and/or noun): 2-hour sessions for 10 weeks, twice a week. Session delivered via teletherapy focusing on verb and/or noun delivered via Zoom with online software (PsychoPy3) on an online platform (Pavlovioa).	Average WAB-AQ score improving >5.03 points following noun treatment in L1 Mandarin Average BNT score improving >3.30 points in the treated language increased significantly after verb treatment in L2 English	Authors reported that noun treatment resulted in treatment gain, within-language generalization, cross-language generalization, better overall lexical retrieval, and more complete utterances. Verb treatment resulted in treatment gain and a cross-language generalization, both more significant than noun treatment, and more generalized effect to lexical retrieval, particularly when treatment targeted L1.

Li et al., 2021	Mandarin English Bilingual	Broca's aphasia (n=1), Anomic aphasia (n=1)	- 2 - 1:1 - 72 (1) - 71-73 - 3390 (810)	Verb Network Strengthening Treatment: 10 treatment sessions and 1 maintenance session after 1 month post-treatment. Delivered by the first author, a Mandarin speaker with a master's degree in speech-language pathology through video conferencing.	Patient 1, McNemar's Chi-squared test: Improvement in correct noun retrieval in the English BNT: ($\chi^2 = 4.45$, $df = 1$, $p = 0.03$); a significant gain of correct verb retrieval ($\chi^2 = 6.4$, $df = 1$, $p < 0.05$) in the VNT of the NAVS	Both treatments will also improve argument production, the accuracy of sentence production in the treated and untreated languages, and generalization to standardized naming (with a larger effect following noun treatment). Authors reported training in Mandarin Verb Network Strengthening Treatment improved verb retrieval ability in Mandarin-English bilinguals with aphasia. Different patterns of within- and between-language generalization effects for both patients. The error analysis demonstrated a reducing trend of semantic errors in both patients, but an increase in cross-language errors in one of the two patients. The authors reported that participants in both groups improved in expressing, comprehension, reading, and writing as suggested by the scores of ABC. Daily living skills have also improved as evidenced by CADL scores. In addition, the improvement of the experimental group is significantly better than the control group. The authors pointed out that the rhythm of the Chinese idioms can improve the accuracy and arity of the participants. The authors also suggested that idiom-based training may assist with cognitive processing.
Pei et al., 2023	Mandarin	Non-fluent aphasia, diagnosed with the aphasia screening scale. Primarily Broca's (n=39) and Transcortical motor (n=29)	- 70 (including 36 served as control) - 50:20 (overall) - 65 (11.3) - NR - NR	Idiom-based Training: 40-minute daily sessions for 2 weeks. Delivered in-person by therapists. Training includes visually viewing the pictures related to the idioms reading the idioms, answering content questions, and oral expression. For the control group, participants received respiratory regulation training, muscle exercise, and vowel pronunciation practice.	Pre-post ABC scores: Expressing ($p < 0.001$): mean +26.8 Comprehension ($p < 0.001$): mean +10.1 Reading ($p < 0.001$): mean + 25.2 Writing ($p = 0.051$): mean +3.9 Experimental-control ABC scores: Expressing ($p = 0.016$): mean +11.1 Comprehension ($p = 0.006$): mean +7.2 Reading ($p = 0.006$): mean + 13.7 Writing ($p = 0.858$): mean +1.2 Pre-post CADL score ($p < 0.001$): +39.6 Experimental-control CADL score ($p = 0.026$): +16.1 10/12 participants showed improvement in the accuracy of targeted items	The authors reported that the executive functions of Cantonese-speaking individuals with anomic aphasia are positively related to the
Yeung & Law, 2010	Cantonese	Aphasia, characterized by moderate-to-severe word-finding difficulties	- 12 - 5:7 - 48.42 (9.19) - 27-61 - 702.50 (610.47)	Visual-based naming activity with hierarchy of cueing: 1-1.5 hour sessions for at most 15		

Zhang et al., 2021	Mandarin	Global aphasia (n=9), Broca's aphasia (n=8), Transcortical mixing aphasia (n=3)	- 40 (including 20 served as control) - 16:4 (15:5 for control) - 52.90 (9.08) - NR - 77.1 (52.2)	sessions. Delivered in-person by the clinician. Melodic Intonation Therapy: 30-minute sessions for 8 weeks, 5 times a week. Delivered by music therapy professionals who have been trained in neurological music therapy (NMT) and have obtained a registered music therapist license. The control group received basic speech therapy provided by speech therapists for the same amount of time and frequency. Both groups also received medication and other care and support.	Significant differences between the experimental group and control group in BDAE score in the following areas***: information (+1.90), fluency (+0.40), repetition (+2.07), true or false (+0.41), word recognition (+1.18), and sequential commands (+1.49). Per the results of two-way ANOVA, post-treatment scores of the groups are significantly different on object naming (+0.75), spontaneous naming (+0.24), sentence completing (+0.07), reaction naming (+0.22), and aphasia quotient (+17.74).	treatment effect of the ortho-phonological cueing approach. Implementing Melodic Intonation Therapy for individuals who speak Mandarin is innovative due to the natural pitch changes associated with the tonal feature of Mandarin. The authors also reported that the participants' familiarity with the trained melodies and songs can also serve as tonal and cognitive cues when they are experiencing expressive language difficulties in the future. Further, the authors reported that the auditory cues in Melodic Intonation Therapy (provided by the music therapist playing a harmonic instrument) facilitated the participants' cross-hemisphere processing, and this resulted in an improvement of participants' performance in listening comprehension, repetition, spontaneous speech, and naming skills as evident by the BDAE score.

*This information is reported in months or years in some articles. For the sake of consistency, one month will be considered as 30 days, whereas one year is considered as 365 days.

**BDAE: Boston Diagnostic Aphasia Examination; FACS: Facial Action Coding System; WAB-AQ: Western Aphasia Battery - Aphasia Quotient; BNT: Boston Naming Test; VNT: Verb Naming Test; NAVS: Northwestern Assessment of Verbs and Sentences; ABC - Aphasia Battery of Chinese; CADL - Comprehensive Activities of Daily Living

*** Scores reported in the following format: area (post-treatment score improvement of experiment group - post-treatment score improvement of control group)

Virtual Reality-based Script Training for Rehabilitation of Functional Communication of Cantonese Speakers with Aphasia: Findings from a pilot randomized controlled trial

Winsy W.S. Wong^{*1}, Donald S. P. Li², Mohammad Momenian¹, Hoi Tsz KWOK¹, Cynthia M. H. Ng¹, Eric H. C. Shih¹, Leanne W. Y. Chung¹, Virginia S. W. Ku¹, & Karen H. L. Wong¹

¹ Speech Therapy Unit, Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University

² Department of Cognitive Science, Zanvyl Krieger School of Arts and Sciences, Johns Hopkins University, Baltimore, Maryland, United States of America

***corresponding author, winsyws.wong@polyu.edu.hk**

Introduction

Aphasia, an acquired language impairment secondary to neurological damage, limits one's participation in daily activities and affects their quality of life (Code & Herrmann, 2003). Researchers have been keen on utilizing technology (e.g., virtual reality) to enhance the treatment outcomes of speech-language therapy (SLT). The current study aimed to investigate the feasibility and preliminary efficacy of using VR in script training (Youmans et al., 2005), an SLT that enhances verbal functional communication via repeated practice of personalized content in various contexts.

Methods

A total of 39 PWA were recruited and randomly assigned to receive computerized script training with VR (n=19) or without VR (n=20). Participants attended 14 biweekly sessions of treatment, each lasting approximately 1 hour. Computerized script training was adapted from Cherney et al. (2008). In the VR treatment group, PWA fitted with a head-mounted display practiced the scripts within an immersive environment, while PWA in the non-VR group practiced the scripts with a computer screen. Performance on their trained script in terms of accuracy and efficiency served as the primary outcome, while the severity of aphasia and performance on verbal functional communication were secondary outcomes. These outcome measures were measured before, immediately after treatment, and 8 weeks post-treatment. Linear mixed models were used to compare participants' performance in the two treatment conditions at various time points. Baseline aphasia severity differed significantly between the treatment conditions; it was therefore treated as a covariate in the statistical comparisons.

Results

The number of PWA who completed treatment in VR and non-VR conditions was 13 and 18, respectively. Significant improvements in the primary outcome were observed in both conditions. When aphasia severity was controlled, no significant difference was present between the two treatment conditions. No observable gains were noted in secondary outcome measures. Although the attrition rate was higher in the VR condition, minimal cybersickness was reported by the PWA.

Conclusions

Findings from the study have provided preliminary evidence supporting the feasibility and efficacy of VR-based computerized script training.

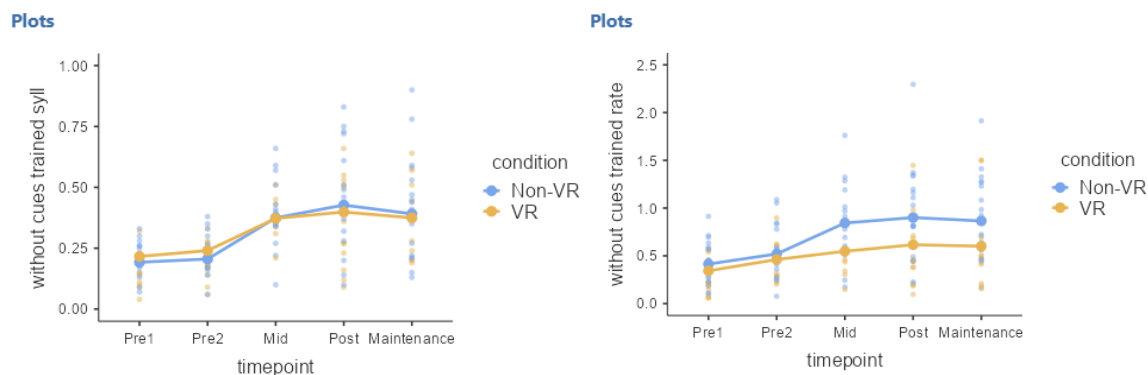
References

- Cherney, L. R., & Halper, A. S. (2008). Novel technology for treating individuals with aphasia and concomitant cognitive deficits. *Topics in Stroke Rehabilitation*, 15, 542-554.
- Code, C., & Herrmann, M. (2003). The relevance of emotional and psychosocial factors in aphasia to rehabilitation. *Neuropsychological Rehabilitation*, 13, 109-132.
- Youmans, G., Holland, A., Muñoz, M., & Bourgeois, M. (2005). Script training and automaticity in two individuals with aphasia. *Aphasiology*, 19, 435-450.

Acknowledgments

We would like to thank the Neighbourhood Advice-Action Council, Hong Kong Society for Rehabilitation, and the Hong Kong Stroke Association for their generous help in subject recruitment.

Figure 1a & b. Performance on primary outcomes (in terms of percentage accuracy and rate of production, respectively) of the two treatment conditions across time points.



Cognitive Mediation of Autonomic Effects on Language Function in Post-Stroke Aphasia

Qiu Yang Xu¹, Meng Huan Wang¹, Ya Ting Sun², Lily Zihe Yin³, Dan Dan Liang^{1*}

¹ School of Chinese Language and Culture, Nanjing Normal University, Nanjing, (Jiangsu), China

² Xuzhou Rehabilitation Hospital Affiliated Xuzhou Medical University, Xuzhou, (Jiangsu), China

³ School of Philosophy, Psychology and Language Sciences, The University of Edinburgh, Edinburgh, United Kingdom

*corresponding author, 03275@njnu.edu.cn

Introduction

Heart rate variability (HRV) is a key physiological marker reflecting autonomic nervous system function and the bidirectional communication between the brain and body. It has been shown to correlate with various cognitive functions, including executive control, decision-making, and emotional regulation (Arakaki et al., 2023), and is considered a potential biomarker for stroke prognosis (Aftyka et al., 2023). Post-stroke aphasia (PSA) is frequently accompanied by executive dysfunction. Although language impairment and executive control are partially dissociable in PSA, both contribute to early post-stroke symptoms of aphasia (Meier et al., 2022). The extent to which these two functions interact remains unclear. Damage to the language network and fronto-temporal connectivity in PSA may also be associated with dysregulation of autonomic function (Zhang et al., 2025). However, the mechanisms linking HRV, cognitive function, and language deficits remain poorly understood.

Methods

A cross-sectional study was conducted with 28 individuals diagnosed with PSA (Table 1). Demographic data and HRV indices were collected, including resting heart rate (HR), the standard deviation of NN intervals (SDNN), the root mean square of successive differences (RMSSD), and high-frequency power (HF). Language ability was assessed using the Western Aphasia Battery (WAB), yielding the Aphasia Quotient (WAB-AQ) and subtest scores: spontaneous speech (SPCH), auditory comprehension (CMPRHN), repetition (RPTN), and naming (NMNG). Cognitive performance was measured using the Montreal Cognitive Assessment (MoCA), with scores divided into six domains: visuospatial/executive (Spat/Exec), attention/inhibitory control (Attn/Inhib), language (Lang), abstraction (Abstr), delayed recall (Delay), and orientation (Orient). Hierarchical regression analyses were used to examine the predictive value of MoCA subdomains and HRV indices on WAB-AQ. Mediation analyses were conducted to evaluate the indirect effects of cognitive domains.

Results

Preliminary correlation analysis revealed that WAB-AQ was significantly positively associated with Attn/Inhib, Spat/Exec, Delay, and SDNN. In Model 1, Attn/Inhib

significantly predicted WAB-AQ, explaining 40.2% of the variance ($R^2 = 0.402$, $p < .001$). Adding Spat/Exec in Model 2 significantly improved model fit ($\Delta R^2 = 0.149$, $p = .008$). In Model 3, the addition of Delay further increased the explanatory power ($\Delta R^2 = 0.207$, $p < .001$), with Delay emerging as a significant predictor ($p < .001$), while Attn/Inhib was no longer significant ($p = .259$). Model 4 introduced SDNN, but the incremental change was not statistically significant ($\Delta R^2 = 0.012$, $p = .287$), suggesting that the effects of Attn/Inhib and SDNN on language outcomes may be mediated by delayed recall (Figure 1A). Mediation analysis confirmed a full mediation effect of overall cognitive function on the relationship between SDNN and WAB-AQ (indirect effect estimate = 0.662, 95% CI [0.402, 1.081], $p < .001$). The effect of mediation varied across cognitive subdomains (Figure 1B).

Conclusions

Our findings suggest that autonomic function (HRV-SDNN) does not directly predict language outcomes in post-stroke aphasia. Instead, its effect is fully or partially mediated by cognitive factors. These results support the relevance of neurovisceral framework and emphasize the value of neurocognitive profiling in aphasia rehabilitation.

References

- Aftyka, J., Staszewski, J., Dębiec, A., Pogoda-Wesołowska, A., & Żebrowski, J. (2023). Heart rate variability as a predictor of stroke course, functional outcome, and medical complications: A systematic review. *Frontiers in Physiology*, 14.
- Arakaki, X., Arechavala, R. J., Choy, E. H., Bautista, J., Bliss, B., Molloy, C., Wu, D.-A., Shimojo, S., Jiang, Y., Kleinman, M. T., & Kloner, R. A. (2023). The connection between heart rate variability (HRV), neurological health, and cognition: A literature review. *Frontiers in Neuroscience*, 17, 1055445.
- Meier, E. L., Kelly, C. R., & Hillis, A. E. (2022). Dissociable language and executive control deficits and recovery in post-stroke aphasia: An exploratory observational and case series study. *Neuropsychologia*, 172, 108270.
- Zhang, R., Hong, J., Zheng, X., Chen, S., Lin, L., & Xiao, Y. (2025). Effects of poststroke heart rate variability on the neurological impairment severity and the prognosis among patients with ischaemic stroke: A scoping review. *BMJ Open*, 15(3), e092826.

Acknowledgments

We thank all participants for their contribution to this work.

Figure 1. Hierarchical regression and mediation effect models

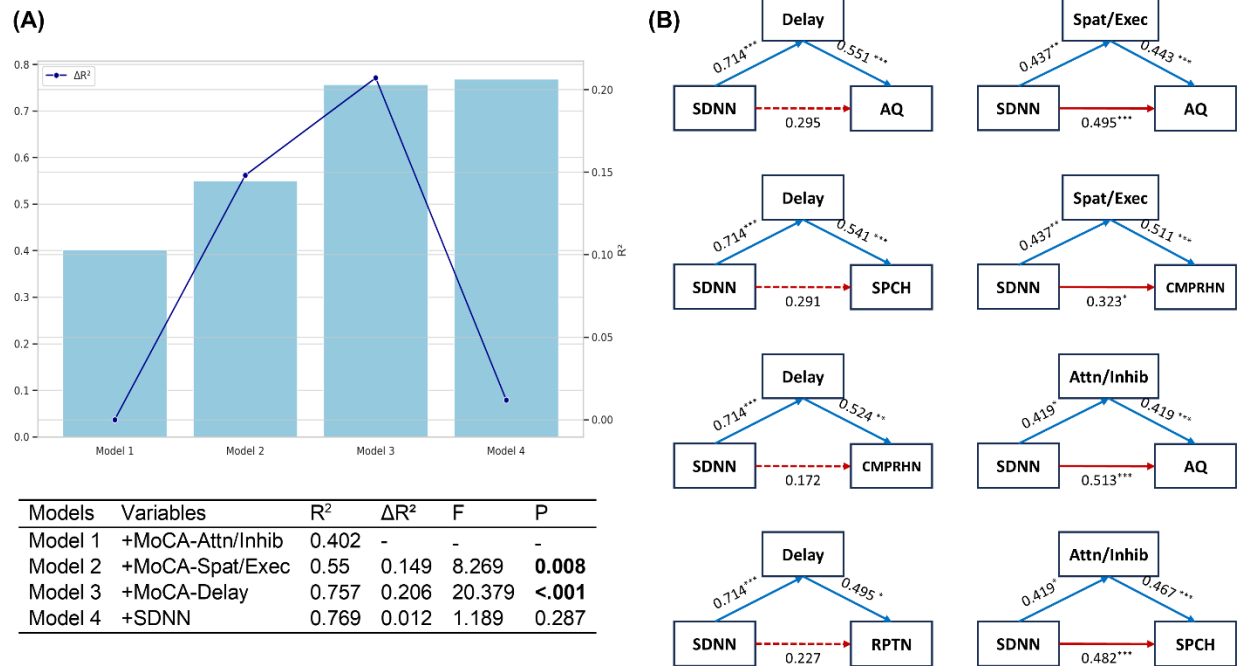


Table 1. The demographic data for participants

	Anomic Aphasia		Broca's Aphasia		t/χ ²	P
	Mean	SD	Mean	SD		
Age	45.714	14.204	50.643	9.771	-1.07	0.295
Gender (F/M)	6/8		10/4		2.333	0.127
Education	11.143	4.148	8.714	2.701	1.836	0.078
Disease Type (I/H)	4/10		7/7		1.348	0.246
Onset Time(m)	3.357	1.737	4.214	1.251	-1.498	0.146
WAB-SPCH	14.5	2.279	5.5	2.794	9.34	<.001
WAB-CMPRH	7.991	0.778	5.554	1.122	6.679	<.001
WAB-RPTN	8.386	1.065	4.893	1.934	5.92	<.001
WAB-NMNG	5.343	1.95	3.343	1.885	2.759	0.01
WAB-AQ	72.476	9.753	38.536	12.768	7.904	<.001
MoCA-Spat/Exec	3.714	1.326	2.286	1.326	2.85	0.008
MoCA-Attn/Inhib	5.929	0.267	4.357	1.151	4.977	<.001
MoCA-Lang	5	0.679	4.143	1.292	2.197	0.037
MoCA-Abstr	1.429	0.852	0.786	0.802	2.056	0.05
MoCA-Delay	3.5	1.829	0.643	0.745	5.413	<.001
MoCA-Orient	5.714	0.469	4.929	1.542	1.824	0.08
MoCA-total	25.286	2.199	17.143	4.538	6.042	<.001
HR	76.714	6.414	82.857	5.803	-2.657	0.013
SDNN	57.38	15.658	37.765	6.3	4.349	<.001
RMSSD	37.062	14.183	32.873	14.372	0.776	0.445
HF	25.139	16.728	22.827	9.082	0.454	0.653

Neural correlates of Apraxia of Speech and their functions in speech production: Evidence from Primary Progressive Aphasia (PPA)

S.C. Angela Xu¹, Donna C. Tippet², Robert Wiley^{3,1}, Brenda Rapp^{1,2} and Kyrana Tsapkini^{2,1}

¹ Department of Cognitive Science, Johns Hopkins University, Baltimore, MD, United States,

² Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, United States,

³ Department of Psychology, University of North Carolina at Greensboro, Greensboro, NC, United States

***corresponding author, angela.xu@jhu.edu**

Introduction

Apraxia of speech (AOS) is a disorder that affects speech motor planning that typically co-occurs with aphasia (higher-level language disorder) and dysarthria (motor execution disorder). However, there is no consensus regarding the neural substrates specifically underlying speech motor planning. While post-stroke AOS has been associated with lesions to left precentral gyrus (PrCG) (Basilakos et al, 2015, 2018; Takakura et al., 2019), AOS caused by neurodegeneration was associated with left premotor cortex and supplemental motor cortex (Utianski et al., 2018; Cordella et al., 2019). In addition, the specific processes involved in speech motor planning are often underspecified.

In this study, we investigate AOS in Primary Progressive Aphasia (PPA, a neurodegenerative language disorder), a less studied population, to evaluate if the diffuse damage profiles can provide additional insights regarding speech planning processes. We aim to answer the following questions: 1) Which brain areas are uniquely associated with AOS? 2) What speech functions are supported by the identified brain areas?

Methods

Participants were 34 right-handed individuals with PPA (12 logopenic, 12 nonfluent, 7 semantic, 3 mixed/unclassifiable; 19 females, mean age = 66.8 years, SD = 7.46). Spoken production was assessed with spoken picture naming (Boston Naming Test, BNT) and single-word repetition (Apraxia Battery for Adults, subtest 2, ABA2). A certified, experienced speech-language pathologist (SLP) rated each PPA participant on the severity of 1) expressive language impairment, 2) AOS and 3) dysarthria, using audio recordings of the two tasks and connected speech.

Analysis 1: Whole-brain voxel-based morphometry (VBM) on the T1-weighted images using FSL-VBM (Douaud et al., 2007) was conducted to identify voxels significantly correlated ($p < .05$) with each of the three SLP ratings, controlling for the other two.

Analysis 2: Multiple linear regression analysis was conducted to test if each cluster of significant voxels accounted for unique variance in the SLP ratings of AOS.

Results

Analysis 1: Expressive aphasia was significantly associated with bilateral, left-lateralized regions within the temporal lobes, and AOS was the left PrCG, postcentral gyrus (PoCG), angular gyrus (AG), and supramarginal gyrus (SMG). No voxels were associated with dysarthria ratings, likely due to small number of participants with dysarthria.

Analysis 2: The sensorimotor PrCG/PoCG cluster ($p = 0.006$) and the parietal AG/SMG cluster ($p = 0.003$) both accounted for unique variance in AOS ratings.

Conclusions

We found that AOS was significantly correlated with cortical volume in left PrCG, suggesting that neurodegenerative and post-stroke AOS affect overlapping cortical regions. In addition, we also discovered novel evidence of the role of SMG/AG in speech motor planning from PPA. Furthermore, our finding that multiple clusters accounted for unique variance in AOS ratings suggests that multiple processes contribute to speech motor planning.

References

- Basilakos, A., Rorden, C., Bonilha, L., Moser, D., & Fridriksson, J. (2015). Patterns of Poststroke Brain Damage That Predict Speech Production Errors in Apraxia of Speech and Aphasia Dissociate. *Stroke*, 46(6), 1561–1566.
- Basilakos, A., Smith, K. G., Fillmore, P., Fridriksson, J., & Fedorenko, E. (2018). Functional Characterization of the Human Speech Articulation Network. *Cerebral Cortex*, 28(5), 1816–1830. <https://doi.org/10.1093/cercor/bhx100>.
- Cordella, C., Quimby, M., Touroutoglou, A., Brickhouse, M., Dickerson, B. C., & Green, J. R. (2019). Quantification of motor speech impairment and its anatomic basis in primary progressive aphasia. *Neurology*, 92(17), e1992–e2004.
- Takakura, Y., Otsuki, M., Sakai, S., Tajima, Y., Mito, Y., Ogata, A., Koshimizu, S., Yoshino, M., Uemori, G., Takakura, S., & Nakagawa, Y. (2019). Sub-classification of apraxia of speech in patients with cerebrovascular and neurodegenerative diseases. *Brain and Cognition*, 130, 1–10. <https://doi.org/10.1016/j.bandc.2018.11.005>.
- Utianski, R. L., Duffy, J. R., Clark, H. M., Strand, E. A., Boland, S. M., Machulda, M. M., Whitwell, J. L., & Josephs, K. A. (2018). Clinical Progression in Four Cases of Primary Progressive Apraxia of Speech. *American Journal of Speech-Language Pathology*, 27(4), 1303–1318. https://doi.org/10.1044/2018_AJSLP-17-0227.

Acknowledgments

This work was supported by grants from the National Institutes of Health through awards R01 DC014475, R01 AG068881, and R01 AG075404. We are grateful to the participants for their unfailing commitment and interest in this study. We also thank referring physicians.

Overarching paragrammatism: Shared circuitry for paragrammatism and syntactic comprehension deficits in post-stroke aphasia

Jeremy D. Yeaton^{1*}, Danielle Fahey², William Matchin³, Dirk Den Ouden³, Julius Fridriksson³ and Gregory Hickok¹

¹ Department of Language Science, UC Irvine, Irvine, CA

² Department of Communicative Disorders, University of Alabama, Tuscaloosa, AL

³ Department of Communication Sciences and Disorders, University of South Carolina, Columbia, SC

*corresponding author, jyeaton@uci.edu

Introduction

Although significant research has investigated overarching agrammatism—comorbid expressive agrammatism and syntactic comprehension deficits (Matchin et al., 2023)—much less has been done to investigate how syntactic comprehension relates to paragrammatism. Whereas expressive agrammatism is characterized by the reduction of syntactic structure in language production, paragrammatism is characterized by insertions and substitutions of grammatical content. Lesion-symptom mapping work has identified neural correlates of paragrammatism in the posterior temporal lobe (Matchin et al., 2020, Yeaton et al., 2025). The posterior temporal lobe has also been implicated in syntactic comprehension deficits (Matchin et al., 2023, Biondo et al., 2024). We hypothesize that a common neural mechanism underlies hierarchical syntactic computation in both production and comprehension, the breakdown of which results in paragrammatic output and poor comprehension of non-canonical sentence structures which require this computation to be interpreted correctly.

Methods

We aggregated data across a number of previously published datasets to identify the lesion and tractographic correlates of paragrammatic production and impaired syntactic comprehension. We operationalize syntactic comprehension in the following ways based on the available data: i) performance on the sequential commands portion of the WAB-R after controlling for single word and yes-no question comprehension, ii) performance on non-canonical (i.e., non SVO word order) sentence comprehension in the NAVS, iii) grammaticality discrimination on an acceptability judgment task, iv) non-canonical sentence comprehension on the SOAP, and v) non-canonical sentence comprehension in a semantic plausibility judgment task. For each of the non-canonical sentence comprehension measures, we regressed out performance on canonical sentence comprehension. For paragrammatism assessment, we calculated the proportion of utterances in a discourse sample that contained paragrammatic intrusions. For each of these measures, we used Support-Vector Regression Lesion-Symptom Mapping to identify the voxel/ROI correlates (DeMarco et al., 2018). We then used DSI Studio (Yeh et al., 2013) to identify and quantify the white matter fiber tracts interrupted by each of the ROIs via atlas-based probabilistic fiber tracking.

Results

Consistent with prior work, we found that the lesion correlates of sentence comprehension deficits after controlling for lower-level comprehension localized to the posterior portion of the temporal lobe. Highest overlap between the lesion correlates of these measures was found in the pSTG, and extended into the pSTS and pMTG (Fig. 1A). An ROI was created by grouping voxels which were associated with at least 3 of the comprehension measures. We found that paragrammatic production was associated with two ROIs: one in the pSTS which overlapped with the comprehension ROI, and another in the superior parietal lobe (Fig. 1A). We found 189 fibers which pass through both the paragrammatism ROI and the adjacent comprehension overlap ROI (Fig. 1B, Table 1).

Conclusions

Although two ROIs are associated with paragrammatism, one of the ROIs has significant volumetric overlap with the identified correlates of syntactic comprehension deficits. We suggest that this posterior temporal ROI and its underlying white matter support hierarchical syntactic computation in both production and comprehension. Thus, although it does not appear that overarching agrammatism is supported by the available data, we suggest overarching paragrammatism—characterized by paragrammatic output and impaired comprehension—which should be caused by lesions in the posterior superior and middle temporal lobe and underlying white matter.

References

- Biondo, N., Ivanova, M. V., Pracar, A. L., Baldo, J., & Dronkers, N. F. (2024). Mapping sentence comprehension and syntactic complexity: evidence from 131 stroke survivors. *Brain Communications*, 6(6), fcae379.
- DeMarco, A. T., & Turkeltaub, P. E. (2018). *A multivariate lesion symptom mapping toolbox and examination of lesion-volume biases and correction methods in lesion-symptom mapping* (Vol. 39, No. 11, pp. 4169-4182). Hoboken, USA: John Wiley & Sons, Inc..
- Matchin, W., Basilakos, A., Stark, B. C., den Ouden, D. B., Fridriksson, J., & Hickok, G. (2020). Agrammatism and paragrammatism: A cortical double dissociation revealed by lesion-symptom mapping. *Neurobiology of Language*, 1(2), 208-225.
- Matchin, W., den Ouden, D. B., Basilakos, A., Stark, B. C., Fridriksson, J., & Hickok, G. (2023). Grammatical parallelism in aphasia: A lesion-symptom mapping study. *Neurobiology of Language*, 4(4), 550-574.
- Yeaton, J., Fahey, D., Gomez, M., Stark, B. C., den Ouden, D. B., Fridriksson, J., & Hickok, G., Matchin, W. (2025). Hierarchical and linear syntactic deficits doubly dissociate in post-stroke aphasia. *PsyArXiv*.
- Yeh, F. C., Verstynen, T. D., Wang, Y., Fernández-Miranda, J. C., & Tseng, W. Y. I. (2013). Deterministic diffusion fiber tracking improved by quantitative anisotropy. *PloS one*, 8(11), e80713.

Acknowledgments

JY was supported by a William Orr Dingwall Dissertation Fellowship. WM, GH, DDO, and JF were supported by a P50 grant from NIDCD.

Figure 1. A: Overlap of lesion correlates of comprehension metrics. Maximum overlap is shown in yellow. Lesion correlates of paragrammatism overlaid in pink. B: ROIs rendered on 3D glass brain, with white matter tracts passing through both ROIs shown.

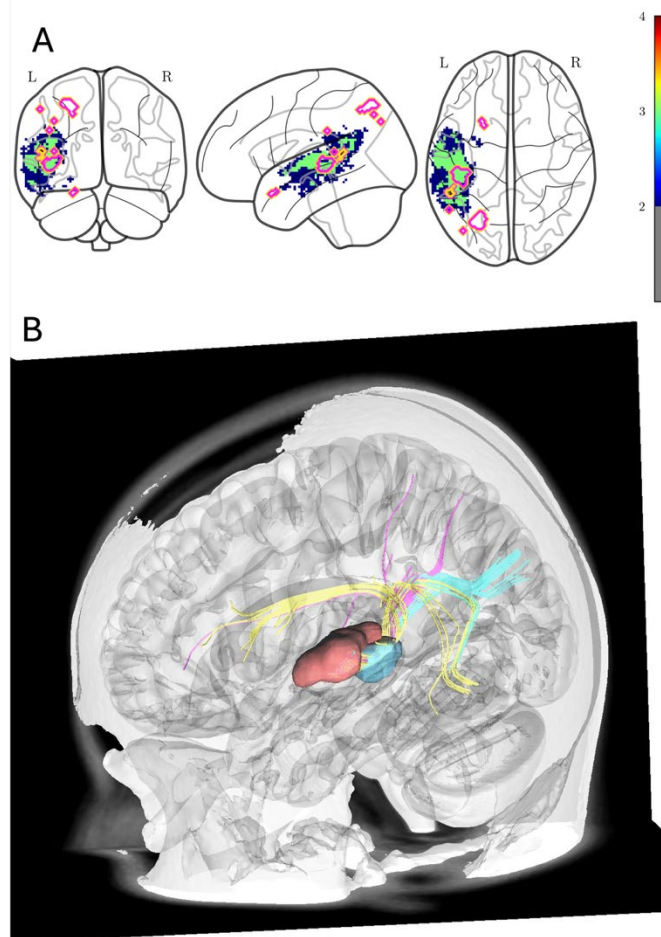


Table 1. Proportion of identified fibers by tract membership. Fibers pass through both the syntactic comprehension ROI and the posterior temporal paragrammatism ROI.

Proportion	Tract
40.2%	Middle Longitudinal Fasciculus L
31.7%	Arcuate Fasciculus L
27.5%	Inferior Longitudinal Fasciculus L
0.5%	Inferior Fronto-Occipital Fasciculus L

Mapping Aphasia Profiles to AI and Human Treatment Decisions: Toward Clinician-Informed Systems

Hyunsoo Yoo*

Department of Communication Science and Disorders, Baylor University, Waco, Texas, USA

*Corresponding author, Hyunsoo_Yoo@baylor.edu

Introduction

As artificial intelligence (AI) systems become increasingly relevant to clinical decision-making, the need for structured, clinician-informed datasets is critical. In aphasia rehabilitation, treatment selection often varies among experts, reflecting diverse theoretical orientations and training backgrounds. Capturing this variation in a systematic and analyzable format is a necessary step toward transparent and trustworthy AI-based recommendation tools. This pilot study investigates agreement between two expert clinicians in aphasia treatment selection and explores how a rule-based AI system aligns with their decisions.

Methods

Six aphasia profiles were constructed from anonymized WAB-R (Western Aphasia Battery-Revised; Kertesz, 2007) scores representing a range of subtypes and severity levels. WAB-R profile data were obtained from AphasiaBank (MacWhinney et al., 2011). Two clinicians independently selected treatment approaches from a predefined checklist and provided brief rationales. Agreement was assessed using Jaccard similarity (Chung et al., 2019), percent agreement, and Cohen's Kappa (Cohen, 1960). Jaccard and percent agreement were computed using custom Python scripts, while Cohen's Kappa was calculated using the `cohen_kappa_score` function from scikit-learn library. All analyses were conducted in Python (v3.10). A rule-based AI engine was developed by mapping WAB-R profile features (e.g., AQ, Naming, Comprehension, Repetition) to expert-informed treatment rules (Hayes-Roth, 1985). These rules were derived from clinician patterns and expanded to address mid-functioning profiles lacking consistent expert agreement. AI-generated recommendations were compared to clinician selections using Jaccard similarity.

AI Logic:

To generate AI recommendations, we developed a rule-based system grounded in patterns across six aphasia profiles. Specific WAB-R thresholds were linked to frequently selected treatments. For example, Naming scores below 6 were consistently associated with Semantic Feature Analysis (SFA; Esfratiadou et al., 2018); and Phonomotor Treatment (Kendall et al., 2015); Comprehension scores below 6 with Auditory Comprehension Training (Wallace et al., 2022); and high AQ scores (≥ 85) with discourse-level interventions. Additionally, for profiles with $AQ < 30$ or Naming = 0, the system prioritized AAC, Visual Action Therapy, and Schuell's Stimulation Approach (SSA; Schuell et al., 1964). These rules were refined to address underrepresented mid-functioning profiles.

Results

Clinician agreement varied across participants. Jaccard similarity between the two clinicians ranged from 0.17 to 0.5, with a mean of 0.40, indicating moderate overlap in treatment selections. Agreement between AI and Clinician A was generally higher (mean = 0.59), while agreement between AI and Clinician B was lower overall (mean = 0.25). Notably, there was complete divergence (Jaccard = 0) between AI and Clinician B for one participant, underscoring directional differences in treatment selection strategies. Percent agreement between the two clinicians ranged from 61.54% to 84.62%, with a mean of 79.49%, suggesting relatively high item-level consistency, likely driven by non-selection of shared irrelevant items. Cohen's Kappa was 0.31, reflecting moderate reliability after accounting for chance agreement. Greater consistency across measures was observed in profiles with higher AQ and Repetition scores.

Conclusions

These findings show that inter-clinician variability reflects meaningful differences in clinical reasoning that can inform AI design. By capturing these patterns, the proposed framework provides a transparent foundation for AI systems that support, not replace, expert judgment. This pilot serves as a proof-of-concept for clinician-informed treatment recommendation models and offers a scalable structure for future learning-based systems.

References

- Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, 20(1), 37–46.
- Chung, N. C., Miasojedow, B., Startek, M., & Gambin, A. (2019). Jaccard/Tanimoto similarity test and estimation methods for biological presence-absence data. *BMC Bioinformatics*, 20, 644.
- Efstratiadou, E. A., Papathanasiou, I., Holland, R., Archonti, A., & Hilari, K. (2018). A systematic review of semantic feature analysis therapy studies for aphasia. *Journal of Speech, Language, and Hearing Research*, 61(5), 1261–1278.
- Hayes-Roth, F. (1985). Rule-based systems. *Communications of the ACM*, 28, 921–32.
- Kendall, D. L., Oelke, M., Brookshire, C. E., & Nadeau, S. E. (2015). The influence of phonomotor treatment on word retrieval abilities in 26 individuals with chronic aphasia: An open trial. *Journal of Speech, Language, and Hearing Research*, 58(3), 798–812.
- Kertesz, A. (2007). *Western Aphasia Battery–Revised (WAB–R)*. Pearson.
- MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for Studying Discourse. *Aphasiology*, 25(11), 1286–1307.
<https://doi.org/10.1080/02687038.2011.589893>
- Schuell, H., Jenkins, J. J., & Jimenez-Pabon, E. (1964). *Aphasia in adults: Diagnosis, prognosis, and treatment*. New York: Harper & Row.
- Wallace, S. E., Patterson, J., Purdy, M., Knollman-Porter, K., & Coppens, P. (2022). Auditory comprehension interventions for people with aphasia: A scoping review. *American Journal of Speech-Language Pathology*, 31(5S), 2404–2420.

Figure 1. Jaccard Similarity Between Clinician Treatment Recommendations and AI Outputs Across Aphasia Profiles

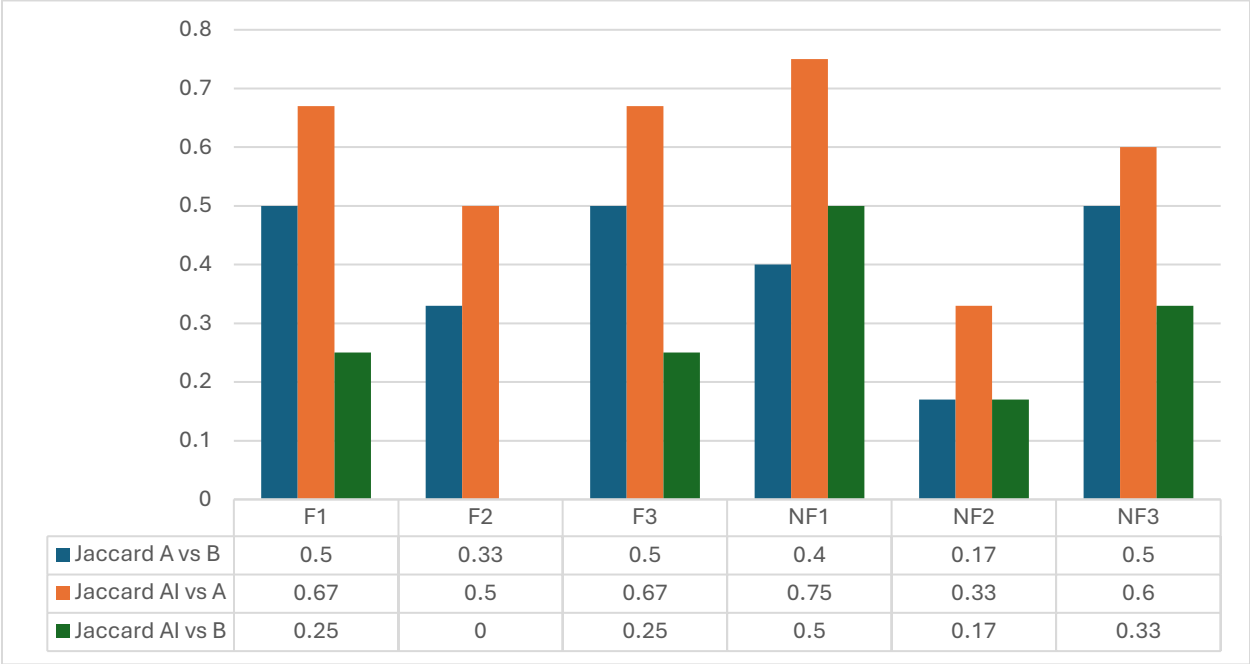


Table 1. Rule-Based AI Treatment Logic

Condition (based on WAB-R scores)	Recommended Treatment(s)	Rationale
Naming < 6	SFA, Phonomotor Treatment	Frequently selected by clinicians
Comprehension < 6	Auditory Comprehension Training	Triggered consistently by clinicians
AQ ≥ 85 or both Naming and Comprehension preserved	Story Retelling, Group Discourse Therapy, SFA	Consensus among clinicians for high-functioning profiles
AQ < 30 or Naming = 0	AAC, Visual Action Therapy, Schuell’s Stimulation Approach (SSA)	Global aphasia protocols; expert judgment
AQ 40–85 AND Naming ≥ 5 AND Comprehension ≥ 6	Script Training, Story Retelling, Group Discourse Therapy	Added by AI to address under-represented mid-range profiles
+ Repetition ≥ 4	MIT, SPP	Added for modeling-based training support

Note: This rule-based AI recommendation logic was derived from observed clinician patterns across six aphasia profiles. It maps treatment strategies to WAB-R profile features, such as AQ, Naming, Comprehension, and Repetition.

Automated Scoring of Story Retelling Performance in People with Aphasia Using Large Language Models

Yae Rin Yoo^{1,2}, Yoonseob Lim², and Jee Eun Sung^{1*}

¹ Department of Communication Disorders, Ewha Womans University, Seoul, Republic of Korea

² Intelligence and Interaction Research Center, Korea Institute of Science and Technology, Seoul, Republic of Korea

* Jee Eun Sung, jeesung@ewha.ac.kr

Introduction

Story retelling (SR) tasks are widely used to assess discourse abilities in persons with aphasia (PWA). Traditionally, SR performance has been evaluated through manual scoring of transcriptions, a process that is both time-consuming and labor-intensive. Moreover, the reliability of such manual assessments in clinical settings has been questioned. To address these limitations, recent advancements in large language models (LLMs) have enabled the development of automated SR (auto-SR) scoring systems (Herrmann, 2025). This study examined whether auto-SR measures can reliably distinguish PWA from healthy adults (HA). Additionally, we investigated the extent to which auto-SR scores are associated with aphasia severity.

Methods

Participants

A total of 10 PWA and 10 HA, matched for age and education, participated in the study. All PWAs had experienced a single left-hemisphere stroke and were diagnosed with aphasia using the Korean version of the Western Aphasia Battery-Revised (Kim & Na, 2012). All HA showed normal performance(>16%ile) on both the Korean Mini-Mental State Examination (Kang, 2006) and the Seoul Verbal Learning Test (Kang et al., 2012).

Tasks

Participants listened to a Korean folktale, *Heungbu and Nolbu* (Bad Older Brother and Good Younger Brother, Choi et al., 2022), and were asked to retell the same story using eight sequential pictures, presented one at a time.

Auto-SR Scoring

Following Herrmann (2025), the text of the original story and participants' recalls were divided into 10 segments (20% overlap), each embedded into a 768-dimensional vector using the Language-agnostic BERT Sentence Embedding model (Feng et al., 2022). A 10×10 Spearman correlation matrix was computed between the original story and recall embeddings and transformed using Fisher's Z. Higher values indicated greater semantic similarity between corresponding segments.

From this matrix, four auto-SR scores were derived: Overall Recall Score (ORS), Original-Order Recall Score (OORS), Primacy Score (PS), and Recency Score (RS) (Figure 1). ORS reflects the semantic accuracy of the retelling. OORS captures preservation of the story's temporal structure. PS and RS indicate serial-position effects. All auto-SR scores in each group followed a normal distribution (Shapiro–Wilk test, $p > .05$).

Results

A one-way ANOVA revealed that PWA demonstrated significantly lower ORS ($F(1,18)=4.629, p=.045$) and OORS ($F(1,18)=5.037, p=.038$) than HA, whereas the group differences were not significant for PS ($F(1,18)=1.551, p=.229$) and RS ($F(1,18)=2.619, p=.123$).

Pearson correlations showed strong, positive relationships between the Aphasia Quotient(AQ) and auto-SR scores (ORS: $r=.781$; OORS: $r=.781$) (Table 1). Significant correlations were also observed between auto-SR scores and AQ sub-domains, including auditory comprehension (ORS: $r=.707$; OORS: $r=.717$), repetition (ORS: $r=.803$; OORS: $r=.812$; PS: $r=.668$), and naming (ORS: $r=.830$; OORS: $r=.864$). No significant correlations were found for the spontaneous speech (ORS: $r=.604$; OORS: $r=.583$; PS: $r=.245$; RS: $r=.327$) sub-domain.

Conclusions

The current study found that overall recall performance reflecting semantic content (ORS) and temporal order-based organization (OORS) reliably captured discourse-level deficits in individuals with aphasia. Both measures showed strong and significant correlations with overall aphasia severity. These findings underscore the clinical utility of automated analysis of connected speech as a promising approach to alleviate the burden of labor-intensive manual scoring for clinicians. Further research is needed to validate these measures across larger and more diverse populations.

References

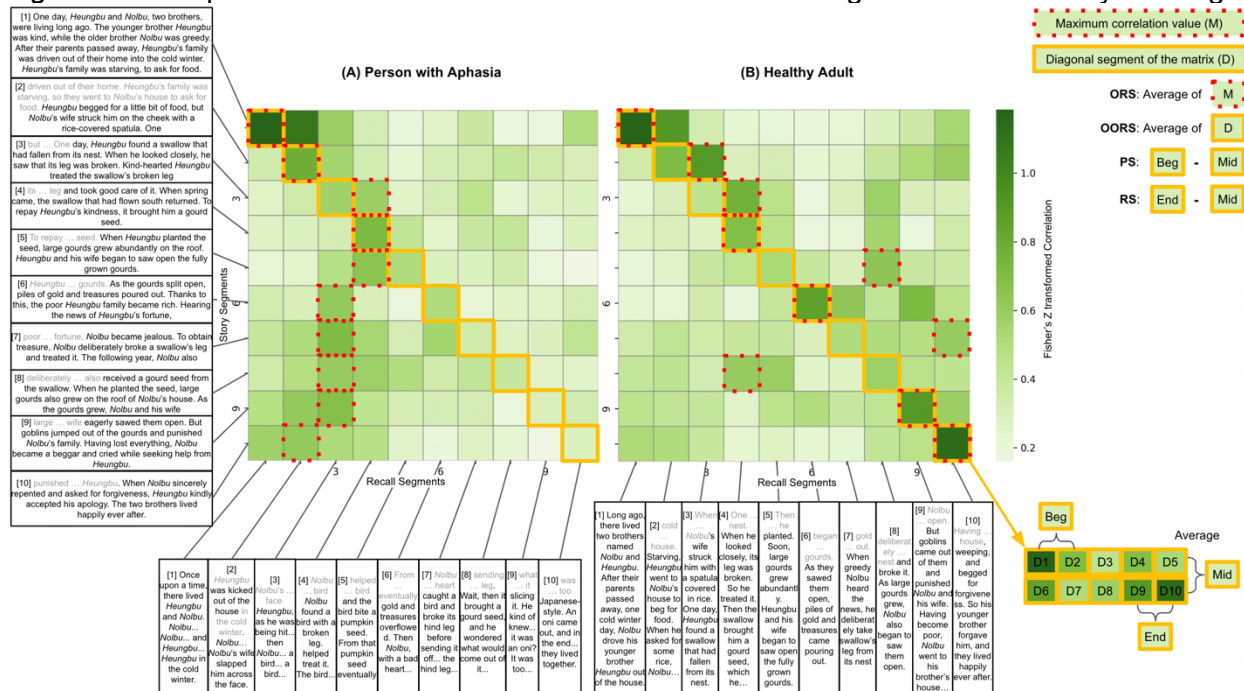
- Choi, S., Lee, H., Jo, E., Lim, Y., Choi, Y., Han, J., & Sung, J. E. (2022). Preliminary procedures to develop storytelling-based assessment for aging and neurogenic disorders. *Communication Sciences & Disorders*, 27(3), 589–605. <https://doi.org/10.12963/csd.22907>
- Feng, F., Yang, Y., Cer, D., Arivazhagan, N., & Wang, W. (2022). Language-agnostic BERT sentence embedding. *arXiv preprint arXiv:2207.04672*.
- Herrmann, B. (2025). Language-agnostic, automated assessment of listeners' speech recall using large language models. *arXiv preprint arXiv:2503.01045*.
- Kang, Y. (2006). A normative study of the Korean-Mini Mental State Examination (K-MMSE) in the elderly. *Korean Journal of Psychology*, 25(2), 1–12. <https://doi.org/G704-001037.2006.25.2.002>
- Kang, Y., Jang, S., & Na, D. L. (2012). *Seoul Neuropsychological Screening Battery-2nd Edition (SNSB-II)*. Human Brain Research & Consulting Co.
- Kim, H., & Na, D. L. (2012). *Paradise: Korean version of the Western Aphasia Battery-Revised (PK-WAB-R)*. Paradise Welfare Foundation.
- Martinez, D. (2024). Scoring story recall for individual differences research: Central details, peripheral details, and automated scoring. *Behavior Research Methods*, 1–17.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Ministry of Science and ICT (MSIT) (No. 2022R1A2C2005062, RS-2024-00461617), by the National Research Council of Science & Technology (NST) grant

funded by MSIT (No. CAP21054-000), by the NRF grant funded by the Ministry of Education (No. NRF-2022R111A4063209), by the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health and Welfare (No. HI23C0156), and by the Korea Institute of Science and Technology (KIST) Institutional Program under Grant 2E33841.

Figure 1. Examples of correlation matrices and automated scoring measures for story retelling



Note. The figure presents Fisher Z-transformed correlation matrices between the 10 original story segments (rows) and 10 corresponding recall segments (columns) for a person with aphasia (A) and a healthy adult (B). Participant responses are shown below each matrix, with overlapping content between segments indicated in gray. Based on these matrices, four automated measures are computed: (1) *Overall Recall Score (ORS)* is an average of the maximum correlation values (M; highlighted in red dashed squares) per row, reflecting overall semantic recall accuracy; (2) *Original-Order Recall Score (OORS)* is the average of average of diagonal correlation values (D; highlighted in yellow squares), representing how similarly and accurately participants recalled the story in its temporal-order structure. (3) *Primacy Score (PS)* indicates the primacy effect, by comparing the early (D1, D2 = Beg) and the middle (D3, D4 = Mid) diagonal correlation values; (4) *Recency Score (RS)* represents the recency effects, by comparing the last two diagonal values (D5, D6 = End) with Mid.

Table 1. Pearson correlation results between automated story retelling scores and aphasia severity

	AQ	Spontaneous Speech	Auditory Comprehension	Repetition	Naming
ORS	.781**	.604	.707*	.803*	.830*
OORS	.781**	.583	.717*	.812**	.864**
PS	.519	.245	.567	.668*	.586
RS	.280	.327	.266	.194	.171

Note. * $p < .05$; ** $p < .01$; AQ = Aphasia Quotient from the Korean version of the Western Aphasia Battery-Revised (Kim & Na, 2012); ORS = Overall Recall Score; OORS = Original Order Recall Score; PS = Primacy Score; RS = Recency Score

RESPALDO: a Psychosocial Education Program for Latino/Hispanic Care Partners of People with Progressive Aphasia

Giselle A. Yoshimoto^{1*}, Katie C. Cole¹, Diana F. Cruz¹, Camille Wagner-Rodriguez¹, Karla Patricia Gutierrez Sanchez², Mariana Longoria Ibarrola², Maria F. Quiñones Vieta¹, Maya L. Henry^{1,3}, and Stephanie M. Grasso¹

¹ Department of Speech, Language, and Hearing Sciences, The University of Texas at Austin, Austin, (Texas), United States

² Instituto Nacional de Neurología y Neurocirugía, México, (Distrito Federal), México

³ Department Neurology, Dell Medical School, Austin, (Texas), United States

***corresponding author, giselle.yoshimoto@utexas.edu**

Introduction

Care partners of individuals with language-prominent dementias, such as primary progressive aphasia (PPA), face distinct and under-addressed challenges stemming from the progressive decline in communication. Unlike programs focused on Alzheimer's disease or stroke-related aphasia, few interventions target the speech and language-specific impairments that characterize PPA (Gorno-Tempini et al., 2011) and other language-prominent dementias (Jokel et al., 2017; Schaffer & Henry, 2023). These challenges are intensified for Latino and Hispanic families, who experience systemic, cultural, and linguistic barriers to dementia care (Aranda et al., 2021; González et al., 2019). While some psychosocial programs have shown benefits for Latino care partners of individuals with Alzheimer's disease (Aranda & Cherry, 2019; Perales-Puchalt et al., 2022), no studies have tailored or tested such interventions for Latino/Hispanic carepartners of individuals with progressive aphasia. This study addresses this gap through the co-development of a culturally responsive, telehealth-based psychosocial education program designed for this underserved population.

Methods

The development of the psychosocial education program was informed by focus group data from Latino/Hispanic care partners and individuals with progressive aphasia or language-prominent dementia. The intervention consisted of two phases: Phase 1, an eight-session educational group program, followed by Phase 2, a four-session communication and conversation training sessions. We also introduced *Ayúdame*, a bilingual WhatsApp-based on-demand caregiving resource. Five care partners completed Phase 1, and three dyads continued to Phase 2. We assessed feasibility using pre-established thresholds ($\geq 80\%$ pre-to-post treatment completion; $\geq 60\%$ retention at follow-up) and acceptability via the Acceptability and Benefit Survey (ABS; an in-house measure), administered at post treatment and follow-up. To examine preliminary patterns of improvement, we compared responses on standardized measures of dementia knowledge, perceived stress, coping, and quality of life across three timepoints, pre-intervention, post-intervention, and three-month follow-up, using Wilcoxon signed-rank tests.

Results

All care partners completed pre- and post-treatment assessments, and three of five (60%) completed the three-month follow-up, meeting feasibility criteria. Acceptability ratings improved over time, with ABS scores ranging from “Somewhat Agree” to “Definitely Agree” at all post-treatment timepoints. The ABS also revealed that dementia knowledge increased from pre-treatment ($M = 16.2$, $SD = 5.89$) to follow-up ($M = 25.33$, $SD = 1.52$). Care partners demonstrated a significant decrease in perceived stress following participation ($p = .028$), as measured by the Perceived Stress Scale. Care partners also showed significant improvement in supportive communication (Dementia Management Strategies Scale Encouragement Subscale; $p = .048$). Satisfaction with the program remained high over time.

Conclusions

This pilot study provides preliminary evidence that a culturally and linguistically tailored, telehealth-based psychosocial education program is a feasible, acceptable, and beneficial intervention for Latino/Hispanic care partners of individuals with language-prominent dementia. Participants demonstrated improvements in dementia knowledge, perceived stress, and communication strategies, with perceived benefits maintained at follow-up. High satisfaction and cultural congruence highlight the importance of responsive, community-informed approaches. As part of ongoing work, thematic analysis of focus group and interview data will provide deeper insight into participants’ caregiving experiences, and perceived benefits of participation.

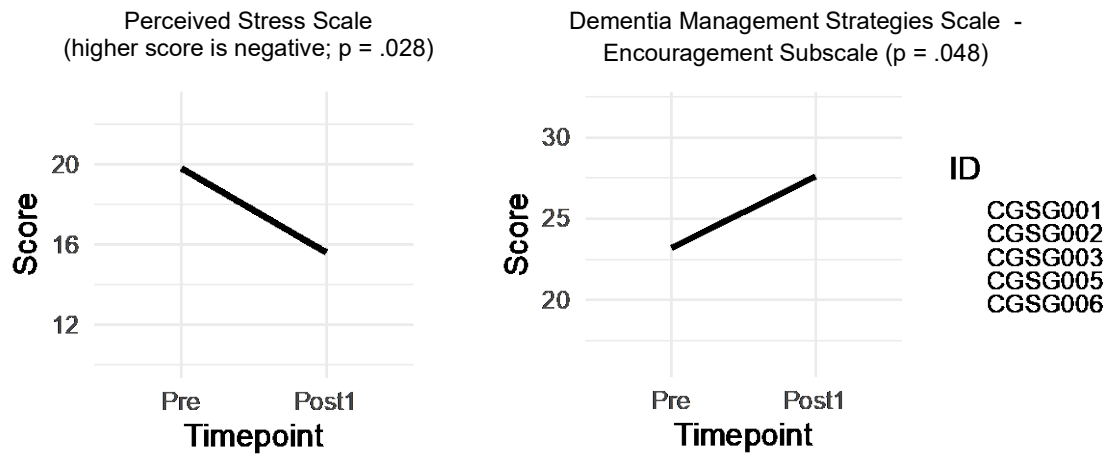
References

- Aranda, M. P., & Cherry, D. (2019). Lessons learned from Savvy Express: A feasibility study of a psychoeducational intervention for care partners. *Innovation in Aging*, 3(Suppl 1), S285–S286. <https://doi.org/10.1093/geroni/igz038.1054>
- Aranda, M. P., et al. (2021). Impact of dementia: Health disparities and interventions. *Journal of the American Geriatrics Society*, 69(7), 1774–1783. <https://doi.org/10.1111/jgs.17345>
- González, H. M., et al. (2019). Cognitive aging among US Latinos: SOL-INCA study. *Alzheimer’s & Dementia*, 15(12), 1624–1632. <https://doi.org/10.1016/j.jalz.2019.08.192>
- Gorno-Tempini, M. L., et al. (2011). Classification of primary progressive aphasia and its variants. *Neurology*, 76(11), 1006–1014. <https://doi.org/10.1212/WNL.0b013e31821103e6>
- Jokel, R., et al. (2017). Group intervention for individuals with primary progressive aphasia and their spouses. *Journal of Communication Disorders*, 66, 51–64. <https://doi.org/10.1016/j.jcomdis.2017.04.002>
- Mesulam, M.-M. (2001). Primary progressive aphasia. *Annals of Neurology*, 49(4), 425–432. <https://doi.org/10.1002/ana.1008>
- Schaffer, J., & Henry, M. L. (2023). Telehealth support for caregivers of people with PPA. *Journal of Speech, Language, and Hearing Research*, 66(2), 482–496. https://doi.org/10.1044/2022_JSLHR-22-00246

Acknowledgments

This project is supported by the Well-Being in FTD Pilot Grant program funded by the Association for Frontotemporal Dementia

Figure 1. Significant Differences in Care Partner Responses from Pre to Post RESPALDO Participation



Responder	Assessment Domain	Assessment Names <i>Italicized assessments were completed independently by care-partners</i>	Pre-Tx	Phase 1 Post-Tx	Phase 2 Post-Tx	3 mo. FU
CAREPARTNER	Quality of Life	<i>ACQoL, QCPR</i>	✓	✓	✓	✓
		<i>BASC, DEMQoL-Carer, PSS</i>	✓	✓		✓
	Coping	<i>Brief COPE, DARS, DMSS</i>	✓	✓		✓
		<i>DMSS</i>	✓	✓	✓	✓
	Neuropsychiatric	<i>Neuropsychiatric Inventory Questionnaire</i>	✓	✓		✓
	Caregiver Burden	<i>Zarit Burden Interview</i>	✓	✓	✓	✓
	Device Proficiency	<i>Mobile Device Proficiency Questionnaire</i>	✓			
	System Usability	<i>System Usability Scale</i>		✓		✓
	Aphasia Severity	<i>PASS Informant</i>	✓	✓		✓
	Support Group Experience	<i>Pre-Tx Survey</i>	✓			
		<i>Semi-Structured Interview</i>	✓	✓	✓	✓
		<i>Acceptability and Benefit Survey (ABS)</i>		✓	✓	✓
	Culture	<i>Acculturation, Bilingual, DUREL, Familism</i>	✓			
	Mental Health	<i>CES-D, GAD-7, GDS</i>	✓	✓		✓
	Dementia Knowledge	<i>Dementia Knowledge Assessment Scale</i>	✓	✓	✓	✓
	General Health	<i>Short Form Health Survey-36</i>	✓			✓
	Social Network	<i>Berkman-Syme Social Network Index</i>	✓	✓		✓
PATIENT	Quality of Life	<i>DEMQoL, SAQoL</i>	✓	✓		✓
		<i>QCPR</i>	✓	✓	✓	✓
	Severity	<i>AIQ,</i>	✓	✓		✓
		<i>MMSE, QAB</i>	✓		✓	✓
		<i>CDR (after interviewing care-partner)</i>	✓	✓		✓
CLINICIAN		<i>PASS Clinician Scale</i>	✓	✓	✓	✓

Note: ACQoL = Adult Carer Quality of Life (Joseph et al., 2012); QCPR = Quality of the Caregiver-Patient Relationship (Spruytte et al., 2002); BASC = Brief Assessment Scale for Caregivers (Glajchen et al., 2005); DEMQoL-Carer = Dementia Quality of Life-Carer (Smith et al., 2005); PSS = Perceived Stress Scale (Cohen et al., 1983); Brief COPE (Carver, 1997); DARS = Devereux Adult Resilience Scale (Mackrain, 2008); DMSS = Dementia Management Strategies Scale (Tan et al., 2013); NPI-Q = Neuropsychiatric Inventory Questionnaire (Kaufer et al., 2000); Zarit Burden Interview (Zarit et al., 1980); MDPQ = Mobile Device Proficiency Questionnaire (Roque & Boot, 2016); System Usability Scale (Brooke, 1996); PASS Informant = Progressive Aphasia Severity Scale – Informant (Sapolsky et al., 2014); Acculturation Rating Scale for Mexican Americans (Dawson et al., 1996); Bilingualism Questionnaire (Birdsong et al., 2012); DUREL = Duke University Religion Index (Koenig & Büssing, 2010); Familism Scale (Steidel & Contreras, 2003); CES-D = Center for Epidemiologic Studies Depression Scale (Radloff, 1977); GAD-7 = General Anxiety Disorder-7 (Spitzer et al., 2006); GDS = Geriatric Depression Scale (Yesavage & Sheikh, 1986); Dementia Knowledge Assessment Scale (Annear et al., 2015); Short Form Health Survey-36 (Ware & Sherbourne, 1992); Berkman-Syme Social Network Index (Berkman & Syme, 1979); DEMQoL = Dementia Quality of Life (Smith et al., 2005); SAQoL = Stroke and Aphasia Quality of Life Scale-39 (Hilari et al., 2003); AIQ = Aphasia Impact on Quality of Life (Swinburn, 2018); MMSE = Mini-mental state exam (Folstein et al., 1975); QAB = Quick Aphasia Battery (Wilson et al., 2018); CDR = Clinical Dementia Rating Scale (Morris, 1997); PASS Clinician Scale = Progressive Aphasia Severity Scale – Clinician Scale (Sapolsky et al., 2014)

Who Benefits from Structural Priming? The Role of Cognition and Language Severity in Aphasia

Peng Zhang^{1*}, Willem van Boxtel², Victor Ferreira³, Nadine Martin⁴ & Jiyeon Lee¹

¹ Aphasia Recovery Lab, Department of Speech, Language, and Hearing Sciences, Purdue University, West Lafayette, IN, United States

² Department of Communication Sciences and Disorders, Louisiana State University, Baton Rouge, LA, USA

³ Department of Psychology, University of California at San Diego, San Diego, CA, USA

⁴ Department of Communication Sciences and Disorders, Temple University, Philadelphia, PA, USA

***corresponding author, zhan5041@purdue.edu**

Introduction

Structural priming – the tendency to reuse previously encountered linguistic structures – has been shown to facilitate language (re-)learning in both neurotypical adults and clinical populations such as people with aphasia (PWA) (Lee, 2024; Pickering & Ferreira, 2008). However, evidence for lasting priming effects in aphasia is limited. Cross-task priming effect (i.e., priming that transfers across different tasks or modalities) has been reported, although evidence for its persistence over time is mixed (Kaschak et al., 2014). Additionally, the mechanisms supporting robust priming-based learning remain unclear, especially given the substantial variability among PWA. To address these gaps, we examined (a) whether PWA and controls show short-term and lasting changes in syntactic production using a task that is different from the priming phase (cross-task priming effects), and (b) how individual differences in cognitive and language abilities modulate training gains.

Methods

Forty-two PWA and 30 age-matched controls participated in a sentence production priming training targeting double-object (DO) dative structures. Over three training sessions, participants orally read DO prime sentences and completed picture descriptions. To assess long-term effects of priming on syntactic choices, an anagram sentence construction task was administered at baseline, and at one day, one week, three weeks, and one month post-training. We predicted that if priming creates lasting syntactic learning in PWA, they would show increased DO production in the anagram task from baseline to post-tests. To examine how individual differences modulate learning outcomes, all participants completed cognitive tests assessing implicit memory (Serial Reaction Time [SRT] and Fragmented Picture Test [FPT]) and explicit memory (Word Pointing Span [WPS]). Language abilities in PWA were assessed using the Western Aphasia Battery–Revised (WAB-R, Kertesz, 2006) and the Northwestern Assessment of Verbs and Sentences (NAVS; Cho-Reyes & Thompson, 2012).

Results

Both groups showed increased DO sentence production in the anagram task from baseline to one day ($z = 12.25$, $p < .001$) and one month post-test ($z = 7.41$, $p < .001$), indicating significant immediate and long-term syntactic learning. Group-level analyses revealed that better cognitive performance predicted greater priming-induced gains, though the effects were smaller for PWA. Within-group analyses showed that higher SRT scores predicted greater long-term (1-month), but not short-term (1-day), priming gains. Severity of language impairment showed robust effects on training outcomes: patients with more severe aphasia (measured by the Aphasia Quotient from the WAB) showed greater benefits immediately post-training ($z = -2.15$, $p = .03$) and at one month ($z = -3.74$, $p < .001$). These findings were further confirmed by ASPT and SPPT scores from the NAVS.

Conclusion

We showed that cross-task structural priming results in syntactic learning in PWA, as reflected by lasting changes in sentence production, similar to controls. Strength in implicit memory (higher SRT scores) contributed to long-term learning outcomes in PWA. Individuals with more severe language impairment showed larger priming effects, consistent with inverse frequency effects (Cho-Reyes et al., 2016). These findings support implicit learning theories of structural priming (Chang et al., 2012). Further results across post-testing time points and theoretical and clinical implications will be discussed.

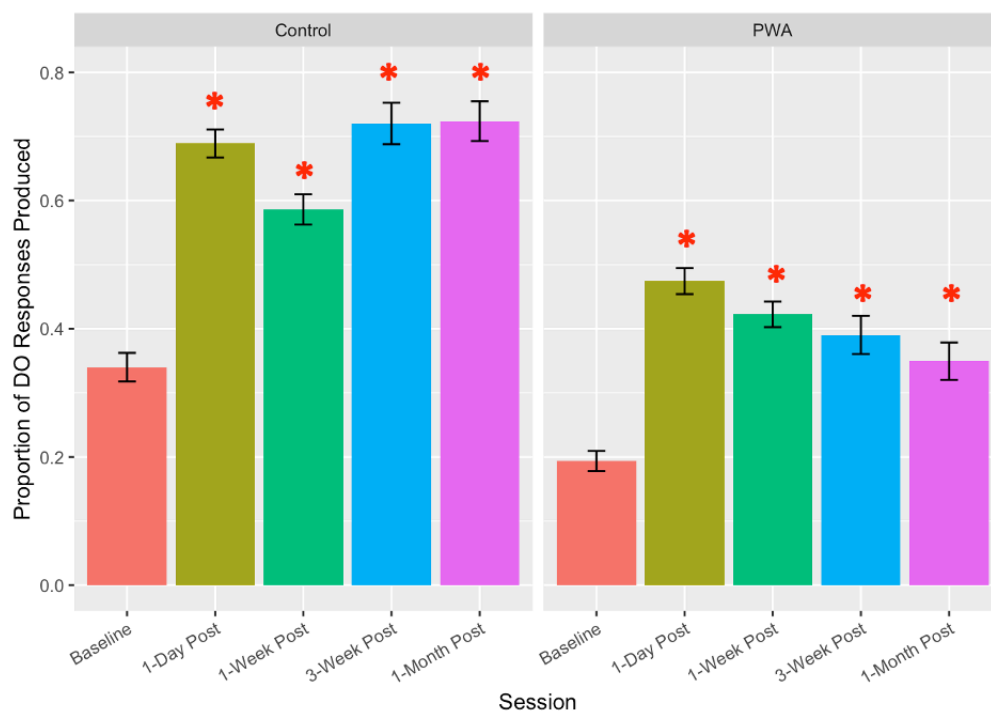
References

- Chang, F., Janciauskas, M., & Fitz, H. (2012). Language adaptation and learning: Getting explicit about implicit learning. *Language and Linguistics Compass*, 6(5), 259–278. <https://doi.org/10.1002/lnc3.337>
- Cho-Reyes, S., Mack, J. E., & Thompson, C. K. (2016). Grammatical Encoding and Learning in Agrammatic Aphasia: Evidence from Structural Priming. *Journal of Memory and Language*, 91, 202–218. <https://doi.org/10.1016/j.jml.2016.02.004>
- Cho-Reyes, S., & Thompson, C. K. (2012). Verb and sentence production and comprehension in aphasia: Northwestern Assessment of Verbs and Sentences (NAVS). *Aphasiology*, 26(10), 1250–1277. <https://doi.org/10.1080/02687038.2012.693584>.
- Kaschak, M. P., Kutta, T. J., & Coyle, J. M. (2014). Long and short term cumulative structural priming effects. *Language, Cognition and Neuroscience*, 29(6), 728–743. <https://doi.org/10.1080/01690965.2011.641387>
- Kertesz, A. (2006). *Western Aphasia Battery–Revised (WAB-R)*. Pro-Ed.
- Lee, J. (2024). Structural priming in aphasia: A state-of-the-art review and future directions. *Aphasiology*, 1–34. <https://doi.org/10.1080/02687038.2024.2445660>
- Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin*, 134(3), 427–459. <https://doi.org/10.1037/0033-2909.134.3.427>

Acknowledgements

This work was supported by NIH R01DC019129.

Figure 1. Proportion of DO responses produced across sessions and groups



Note. * indicates a significant difference between post-test and baseline based on post-hoc analyses with Tukey adjustment

Mapping Cerebellar Volume Patterns in Primary Progressive Aphasia and Its Underlying Neuropathologies

Viktoria Zilkova^{1*}, Nayana Ramesh¹, Adithya Sathyamurthy¹, Jordan Q. Behn¹, Tamar D. Gefen^{1,2}, Changiz Geula^{1,3}, Marek-Marsel Mesulam^{1,4}, Elena Barbieri^{1,5}

- 1 Center for Cognitive Neurology and Alzheimer's Disease, Northwestern University Feinberg School of Medicine, Chicago, IL, USA
- 2 Department of Psychiatry and Behavioral Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL, USA
- 3 Department of Cell and Developmental Biology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA
- 4 Ken and Ruth Davee Department of Neurology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA
- 5 Department of Physical Medicine and Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, IL, USA

***corresponding author, viktoria.zilkova@northwestern.edu**

Introduction

Emerging evidence suggests that different types of frontotemporal dementia exhibit distinct patterns of cerebellar atrophy (Devita et al., 2021), raising the question of whether patterns of cerebellar atrophy may help provide insights into the underlying neurodegenerative processes. While the role of the cerebellum in cognition has been traditionally considered to be limited to motor control (Rudolph et al., 2023), recent studies have underscored its role in language processing (e.g., Schmahmann, 2019). Investigating cerebellar changes in a language-based dementia such as Primary Progressive Aphasia (PPA), thus becomes particularly relevant. The present study examined cerebellar volume in groups of individuals with PPA and autopsy-confirmed neuropathologic diagnosis of either Alzheimer's Disease (AD), Corticobasal Degeneration (CBD), TDP-43 proteinopathy (TDP-C), or Progressive Supranuclear Palsy (PSP), with the aim to explore whether patterns of cerebellar atrophy differed based on the underlying neuropathology.

Methods

T1-weighted MPRAGE scans obtained from 39 PPA participants with autopsy-confirmed neuropathological diagnoses (AD = 11, CBD = 10, TDP-43 = 10, PSP = 8; mean age = 66 years; 21F/18M) and 39 age- and gender-matched healthy participants were processed using a combination of automated pipelines for segmentation and normalization (using SUI2 for SPM12) followed by manual modification of probabilistic cerebellar maps (performed in MRICron). Data were acquired on matched scanner types (Prisma/Trio) across groups. Regional gray matter volume was extracted from 34 cerebellar regions-of-interest (ROIs) defined by the Diedrichsen atlas (2009), standardized to z-scores using scanner-specific control group references, and analyzed using one-way MANOVA and canonical correlation analysis (CCA).

Results

MANOVA revealed that patterns of cerebellar ROI volumes significantly differed among the four groups of PPA based on neuropathology. CCA identified two canonical dimensions, each representing a unique combination of cerebellar ROI volume patterns that contributed to the group differences.

The first dimension predominantly loaded on left cerebellar regions (VIIIa, V, VIIb, VIIIb, Crus I), the second dimension emphasized right-sided lobules and vermis regions (right V, right VI, Vermis VIIb, Vermis IX, and Left IX). Projections into canonical space indicated that cerebellar volume profiles may enable *in vivo* differentiation between tauopathies, specifically PSP and CBD.

Conclusions

The results of this study indicate that cerebellar atrophy is a prominent feature in individuals with PPA, with distinct patterns of atrophy associated with different underlying proteinopathies. Notably, the involvement of specific regions VIIb, VIIIa, and VIIIb aligns with a previous single-case report from our group, where atrophy in these areas was linked to progressive isolated reading aloud impairment (Barbieri et al., 2024). The clear separation of neuropathology groups in canonical space suggests disease-specific patterns of cerebellar atrophy that may serve as *in vivo* biomarkers of 4-repeat tauopathies, thereby aiding the differential diagnosis of neurodegenerative diseases. Future directions include investigating the relationship between cerebellar atrophy and language deficits observed in PPA.

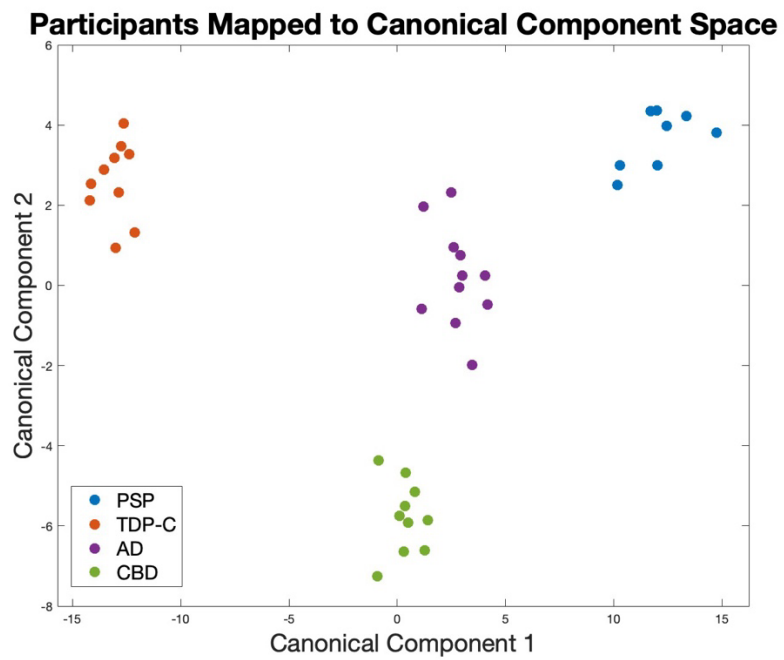
References

- Rudolph, S., Badura, A., Lutz, S., Pathak, S. S., Thieme, A., Verpeut, J. L., ... & Fioravante, D. (2023). Cognitive-affective functions of the cerebellum. *Journal of Neuroscience*, 43(45), 7554-7564.
- Devita, M., Alberti, F., Fagnani, M., Masina, F., Ara, E., Sergi, G., ... & Coin, A. (2021). Novel insights into the relationship between cerebellum and dementia: A narrative review as a toolkit for clinicians. *Ageing Research Reviews*, 70, 101389.
- Diedrichsen, J., Balsters, J. H., Flavell, J., Cussans, E., & Ramnani, N. (2009). A probabilistic MR atlas of the human cerebellum. *neuroimage*, 46(1), 39-46.
- Schmahmann, J. D. (2019). The cerebellum and cognition. *Neuroscience letters*, 688, 62-75.
- Barbieri, E., Salvo, J. J., Anderson, N. L., Simon, S., Ables-Torres, L., Los, M. A., ... & Mesulam, M. M. (2024). Progressive verbal apraxia of reading. *Cortex*, 178, 223-234.

Acknowledgments

We acknowledge the neuroimaging team, including Professor Todd Parrish and Daniel Gutstein, for their contributions. This study was supported by the National Institutes of Health through grants 5R01AG077444 (P.I.: M-M.M.), P30AG072977 and P30AG013854 (Mesulam Center Grants).

Figure 1. Canonical Correlation Analysis of Cerebellar Volumes Across Neuropathology Groups



Evaluating Speech Entrainment as a Treatment for Non-Verbal Individuals with Aphasia: A Case Study

Shauna Zodrow, B.S. & Marja-Liisa Mailend, Ph.D.*

¹ Jefferson Moss Rehabilitation Research Institute, Elkins Park, PA, USA

*corresponding author, marja-liisa.mailend@jefferson.edu

Introduction

Restoring verbal communication in individuals with severe nonfluent aphasia, including people with aphasia who rely on non-verbal communication, remains a major clinical challenge. Speech entrainment—speaking in unison with an auditory or audiovisual model—has shown promise in enhancing verbal output in this population (Fridriksson et al., 2012). Additionally, studies have shown that individuals with severe chronic aphasia can improve daily communication and sentence production with script treatment (e.g., Rhodes & Isaki, 2018), a treatment approach which typically includes a speech entrainment component. This pilot study explores the feasibility of speech entrainment for promoting independent speech in non-verbal people with aphasia.

Methods

A 41-year-old woman (L.D.) with chronic nonfluent aphasia participated. She used a Lin Graphica AAC device to communicate, though she could produce yes/no responses verbally. Consent was provided by her Legal Authorized Representative, with L.D.'s assent. Background testing assessed cognitive-linguistic and sensory function. The experiment consisted of three sessions of treatment scheduled on separate days. In treatment, the participant practiced telling three short stories in unison with a recorded audiovisual model. Each story was practiced 12 times per session divided between three blocks. Independent speech was probed before each session and at the end of each practice block. The probes were recorded and transcribed. Self-ratings of focus and energy were also collected before and after each session. The primary outcome was correct intelligible script words; secondary outcome was unique words. Cohen's *d* was used to estimate effect size (Beeson & Robey, 2006); however, non-overlapping data (PND) was used for script words due to lack of variability in the pre-treatment probes.

Results

Following treatment, L.D. demonstrated increased production of script words and unique words across all narrative samples (Figure 1). The PND was 100% for comparing treatment and retention probes to pre-treatment, indicating consistent improvement. Furthermore, a medium effect was observed for unique words, calculated between the difference of pretreatment ($M = 3.67$, $SD = 1.15$) and retention probes ($M = 9.67$, $SD = 4.73$; Robey et al., 1999). L.D. reported increased energy and focus following each session. On a 9-point Likert scale (0–8), her average pre-session ratings were 4.3 for energy and 5.0 for focus, which increased to 6.7 and 6.0, respectively, post-session—reflecting average gains of 2.3 points in energy and 1.0 point in focus across all speech entrainment sessions.

Conclusions

These preliminary findings suggest that speech entrainment may be a feasible and effective intervention for promoting independent speech production in individuals with chronic, severe aphasia who use non-verbal methods for everyday communication. L.D.'s significant gains in intelligible word production from only a few sessions of entrainment therapy along with increased self-reported energy and focus levels encourage further study of speech entrainment therapy in this population. Further research with full-scale treatment and larger sample is needed to explore treatment gains over a longer time-period and their possible generalization to different communication contexts.

References

- Beeson, P. M., & Robey, R. R. (2006). Evaluating single-subject treatment research: Lessons learned from the aphasia literature. *Neuropsychology Review*, 16, 161-169.
- Fridriksson, J., Hubbard, H. I., Hudspeth, S. G., Holland, A. L., Bonilha, L., Fromm, D., & Rorden, C. (2012). Speech entrainment enables patients with Broca's aphasia to produce fluent speech. *Brain*, 135(12), 3815-3829.
- Rhodes, N. C., & Isaki, E. (2018). Script training using telepractice with two adults with chronic non-fluent aphasia. *International Journal of Telerehabilitation*, 10(2), 89-103.
- Robey, R. R., Schultz, M. C., Crawford, A. B., & Sinner, C. A. (1999). Single-subject clinical-outcome research: Designs, data, effect sizes, and analyses. *Aphasiology*, 13(6), 445-473.

Acknowledgments

Research reported in this abstract was supported by the National Institute On Deafness And Other Communication Disorders of the National Institutes of Health under Award Number R21DC018893.

Figure 1. Example figure body text

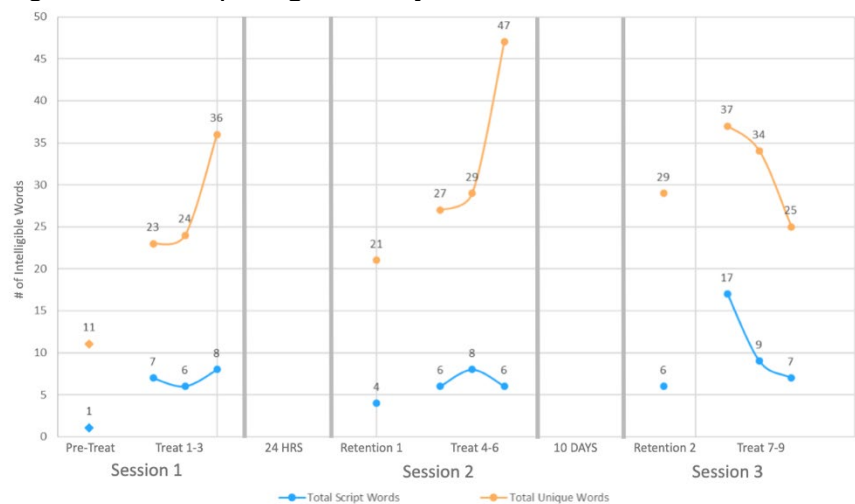


Table 1. Example table body text

Background Data	
Western Aphasia Battery	
Aphasia Quotient (/100)	10.32
Spontaneous Speech (/20)	0
Information Content (/10)	0
Fluency (/10)	0
Repetition (/10)	0.06
Comprehension (/10)	5.1
Naming (/10)	0
Audiometric Screening (Pass/Fail)	Passed at 30 dB for 2000Hz & 4000Hz
Visual Perimetry Screening (Pass/Fail)	Passed at all upper & lower quadrants
Edinburgh Handedness Index	Right-Handed
Synonym Triplets (/30)	18/30 (60%)
Camels & Cactus (/64)	51/64 (80%)
Ravens Progressive Matrices (/36)	32/36 (89%)