



## Evidence for Strengthening of Lexical-Phonological Connections After a Phonological Treatment for Anomia

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August 26, 2021

# Evidence for strengthening of lexical-phonological connections after a phonological treatment for anomia

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## Introduction

According to the Interactive Activation (IA) model, word retrieval depends on spreading activation across semantic, lexical, and phonological nodes (Foygel & Dell, 2000). Brain damage may cause disturbances at any level, introducing noise into the network and resulting in anomia, a difficulty finding words.

Although numerous studies have demonstrated improvements in naming accuracy after anomia therapy, evidence for generalization of these treatment effects is limited; the mechanisms underlying treatment generalization remain poorly understood (Webster, Whitworth & Morris, 2015). Word retrieval network noise can result in various types of speech errors. Changes in speech error production pre- to post-treatment may thus provide more nuanced insights into the mechanisms underlying generalization, in contrast to more commonly used measures such as overall naming accuracy. The mechanisms underlying generalization were investigated by measuring pre- to post-treatment changes in speech error profiles, which were quantified according to the Semantic-Phonological (SP) computational model of lexical retrieval, within the IA theoretical framework (Foygel & Dell, 2000).

## Methods

The present study reports on pooled data from three previously published studies (Leonard, Rochon & Laird, 2008; Leonard et al., 2015; Simic et al., 2020), involving 24 adults (M =62.54 years old; SD =14.41) with chronic (M =43.63 months post-onset; median =18.50; SD =53.89) post-stroke aphasia. Participants presented with Broca's (n=15), Anomic (n=5), Mixed nonfluent (n=1), Conduction (n=1) and Wernicke's (n=2) aphasia types. Anomia was a significant feature of all participants' language profiles (Boston Naming Test range 0-60% correct; M =24.99%; SD =16.91%). Participants were treated three times a week with the Phonological Components Analysis (PCA) protocol, which is a sound-based treatment, using guided self-cueing to stimulate word-retrieval (Leonard et al., 2008). Generalization to an untrained

naming task, the Philadelphia Naming Test (PNT), was assessed pre- and post-treatment using detailed scoring procedures (Roach et al., 1996). Primary outcome measures were pre- and post-treatment PNT naming accuracy, and individual pre- and post-treatment *semantic s-* and *phonological p-weights*, which were obtained using WebFit (Walker & Hickock, n.d.), an online computational modelling tool.

## Results

Pre- to post-treatment, mean PNT naming accuracy significantly improved ( $t(23) = -5.10, p < .001$ ), and the number of omissions ( $t(23) = 3.31, p = .003$ ) and nonword errors ( $t(23) = 2.77, p = .011$ ) significantly decreased. Notably, average *phonological p-weights* significantly improved pre- to post-treatment ( $t(23) = -3.61, p = .001$ ), whereas *semantic s-weights* did not change ( $t(23) = -0.51, p = .618$ ).

## Conclusions

Results suggest that generalized naming improvements after PCA therapy are mediated by a strengthening of lexical-phonological connections (i.e., *p-weights*) in the word retrieval network. PCA therapy may induce stronger feedforward and feedback spreading activation between lexical and phonological nodes, resulting in more precise lexical activation, and increased accessibility of words. Analyses of the impact of various psycholinguistic characteristics (e.g., phonological neighborhood density) on pre- to post-treatment PNT naming accuracy are currently under way. This study provides novel insights into the mechanisms underlying generalization after a phonological treatment for anomia. Understanding such mechanisms is critical to optimizing existing treatments and building novel therapy protocols that are more likely to generalize.

## References

- Foygel, D., & Dell, G. S. (2000). Models of impaired lexical access in speech production. *Journal of Memory and Language*, 43, 182–216.
- Leonard, C., Laird, L., Burianova, H., Graham, S., Grady, C., Simic, T., et al. (2015). Behavioural and neural changes after a “choice” therapy for naming deficits in aphasia: Preliminary findings. *Aphasiology*, 29(4), 506–525.
- Leonard, C., Rochon, E., & Laird, L. (2008). Treating naming impairments in aphasia: Findings from a phonological components analysis treatment. *Aphasiology*, 22(9), 923–947.
- 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.
- Simic, T., Chambers, C., Bitan, T., Stewart, S., Goldberg, D., Laird, L., Leonard, C., & Rochon, E. (2020). Mechanisms underlying anomia treatment outcomes. *Journal of Communication Disorders*, 88, 106048–106048.
- Walker & Hickok (n.d.). Computational Models of Aphasia. Retrieved from, <http://cogsci.uci.edu/~alns/webfit.html>.
- Webster, J., Whitworth, A., & Morris, J. (2015). Is it time to stop “fishing”? A review of generalisation following aphasia intervention. *Aphasiology*, 29(11), 1240–1264.

**Acknowledgments**

Portions of this work were presented at the 2020 Academy of Aphasia meeting. This work was supported by the Canadian Institutes of Health Research [grant 44069 awarded to E. Rochon and C. Leonard], the Heart and Stroke Foundation [grants: 7308, 7015, 5379 and 6092; awarded to E. Rochon and C. Leonard], and by the Canadian Partnership for Stroke Recovery [scholarship awarded to T. Simic]. Funding sponsors had no further involvement in the study. The authors would especially like to thank the participants for their patience and perseverance, and we thank the referring clinicians at the Aphasia Institute and the March of Dimes Aphasia and Communication Disabilities Programs across Ontario.