

## A Treatment Sequence for “Phonological Aphasias”: Strengthening the Core Deficit

### ABSTRACT

Phonological impairment is a common core deficit in individuals with left perisylvian damage resulting in the classic aphasia syndromes (Broca’s, Wernicke’s, and Conduction aphasia). The impairment is particularly evident on written language tasks that require transcoding of sound-letter correspondences, such as nonwords, but many individuals with these chronic “phonological aphasias” have limited residual ability to write real words as well. We report here on a treatment sequence intended to strengthen phonological skills in individuals with aphasia and global agraphia. Treatment outcomes from a case series of 16 participants demonstrated the value of this approach for written and spoken language.

### INTRODUCTION

Damage to the left perisylvian language structures typically results in one of the classic aphasia syndromes (Broca’s, Wernicke’s, Conduction). Although the characteristic features of spoken language in these aphasia types are quite different from one another, they share a common deficit in phonological processing. The phonological impairment is often apparent on tasks that require sublexical manipulation of phonemes and corresponding orthography, such as reading or spelling nonwords. The nonword stimuli sample performance in a context that does not allow reliance on lexical knowledge, and the discrepancy between real word and nonword reading/spelling performance is often striking. The resulting profiles, referred to as “phonological alexia” and “phonological agraphia,” are well documented following left perisylvian damage (Rapcsak et al., 2009). Less attention has been paid to the phonological deficit in individuals who also have marked impairment at the lexical level so their reading/spelling skills are minimal for nonwords *and* real words, that is, those with global agraphia.

Previous research has shown that individuals with aphasia and global agraphia can respond to lexical spelling treatment and relearn the written spellings of targeted words (Beeson, et al., 2003). Somewhat limited effort has been directed toward strengthening sublexical phonological skills in such individuals, presumably due to the severity of the phonological deficit and the questionable value of such treatment at a functional level. In other words, treatment focus has typically remained at the lexical level, retraining spoken and/or written production of functional words. In this study, we specifically explored the value of phonological treatment in a case series that included individuals with aphasia and global agraphia to determine whether it was possible to remediate/lessen this core phonological deficit and to explore its value in a broader sequence of language rehabilitation. We report the outcomes from the phonological component of a treatment sequence aimed at improving overall written and spoken language skills in individuals with aphasia.

### METHOD

#### Participants

Sixteen individuals with aphasia and acquired global agraphia participated in this study. The average age of participants was 56 (29-71) and they were an average of 4.4 years post onset of aphasia (5 months-13 years). Extensive behavioral assessment was conducted to characterize spoken and written language abilities. Based on their performance on the *Western Aphasia Battery*, participants included 8 individuals with Broca’s Aphasia, 4 with Wernicke’s and 4 with Conduction Aphasia. Reading and spelling performance was assessed using the *Arizona Battery for Reading and Spelling*, a list of regular,

irregular and nonwords. Performance of <30% accuracy on real word spelling determined the classification of global agraphia. All participants were unable to read or spell nonwords, and demonstrated significant phonological impairment on a battery of phonological tasks.

## Treatment

Individuals with aphasia and global agraphia participated in a sequence of treatments aimed at strengthening lexical-semantic, phonologic, and orthographic skills (Figure 1). Based on their global agraphia profile, all participants began therapy with **Lexical Treatment**, which used the Copy and Recall Treatment (CART) protocol to retrain naming and written spelling of a set of 24 “key words” to be used for the next phase: phonological treatment. **Phonological Treatment** consisted of retraining sound-letter, letter-sound correspondence for 20 consonants and 12 vowels, and training “blending” of sounds in the context of spelling low frequency real words and nonwords. Upon successful completion of the phonological treatment phase, participants were entered into **Interactive Treatment**, which promoted the use of lexical and phonological strategies to detect and correct spelling errors.

The typical therapy schedule for each phase of treatment included hour-long sessions with a clinician twice weekly, and approximately 5 hours of homework per week. The course of treatment ranged from 4-12 months, depending on individual response to treatment and time necessary to meet pre-established criterion in each treatment phase.

## RESULTS

All 16 participants successfully completed lexical treatment and entered phonological treatment; however, they diverged into two groups regarding their ability to master all of the skills targeted in phonological treatment (Figures 2 & 3). Nine individuals were unable to meet criteria to progress through the entire phonological treatment. When examined as a group, these participants had greater impairment of sound-letter/letter-sound correspondences prior to treatment. As shown in Figure 2, they made gains in sublexical skills following treatment, but they did not appear to generalize these skills to reading or spelling of untrained words. However, this group demonstrated improvement in overall language abilities after phonological treatment, with improvements in their Aphasia Quotients on the WAB (Table 1). Furthermore, 3 individuals from this cohort participated in a lexical retrieval treatment, in which the phonological “boost” they received from phonological treatment was engaged for self-cueing for naming.

Seven participants completed all phases of phonological treatment and progressed to interactive treatment. As shown in Figure 3, this subgroup had less impaired sublexical skills, and ultimately showed more improvement in sound-letter/letter-sound correspondences and greater generalization to reading and spelling of untrained words. They also demonstrated some gains in overall language ability, as evidenced by increase in Aphasia Quotients on the Western Aphasia Battery (Table 1), and three participants demonstrated improved ability to use both phonemic and orthographic self-cueing for naming in a subsequent lexical retrieval treatment.

The functional value of strengthening phonological skills in individuals with severe phonological impairment can be illustrated by two individual examples from the case series. The first participant, a 67 year-old woman with Wernicke’s aphasia (AQ= 58.7), participated in lexical → phonological treatment at 7 years post-stroke. She was able to re-learn sound/letter, letter/sound correspondences for consonants, but was unable to re-learn vowels. Following treatment, she demonstrated overall improvement in sublexical skills, her WAB AQ increased by nearly 7 points, and she greatly benefitted

from lexical retrieval treatment that engaged her phonological skills to aid in self-cueing of naming (Table 2).

The second participant was a 65-year old man with a profile of Broca's aphasia (AQ = 41). Following lexical → phonological → interactive treatment, he showed improved sublexical skills that generalized to reading and spelling of real words (Table 2). He had slight improvement in his WAB AQ, and he was able to functionally demonstrate use of orthography and phonology to cue spoken production. The personal impact of his successful use of orthographic self-cueing for everyday communication was dramatic for this individual and his wife.

## DISCUSSION

The goal of this research was to evaluate the benefit of phonological treatment as part of a sequence of interventions intended to improve overall language performance in individuals with chronic aphasia and global agraphia. Treatment outcomes suggest that individuals with severe phonological impairment can benefit from therapy directed at strengthening the core phonological deficit. The benefits of treatment played out in slightly different ways, with those individuals who had more spared phonological skills at the outset demonstrating improved overall written language performance as a function of improved sublexical skills. Those with more significantly impaired phonology overall demonstrated improved sound-letter/letter-sound correspondences after treatment, but this was not adequate to markedly improve written language. However, phonological treatment was associated with a positive effect on overall language performance, and in some individuals, the phonological "boost" was shaped in subsequent treatments to aid in lexical retrieval. In sum, these outcomes support the value of phonological treatment as an important component of rebuilding a foundation for advancing spoken and written language production in individuals with chronic aphasia.

## References

- Beeson, P.M, Rising, K., & Volk, J. (2003). Writing treatment for severe aphasia: Who benefits? *Journal of Speech, Language and Hearing Research, 46*, 1038-1060.
- Rapcsak, S.Z., Beeson, P.M., Henry, M.L., Leyden, A., Kim, E., Rising, K., et al. (2009). Phonological dyslexia and dysgraphia: Cognitive mechanisms and neural substrates. *Cortex, 45*, 575-591.

Tables and Figures

Table 1: Aphasia types and Mean *Western Aphasia Battery* Aphasia Quotients (AQ) pre- and post-treatment.

Western Aphasia Battery	Aphasia Types	Pre-Tx Mean AQ (sd)	Post-Tx Mean AQ (sd)
Lexical → Phonological	4 Wernicke's 5 Broca's	39.5 (13.6)	44.11 (16.9)
Lexical → Phonological → Interactive	4 Conduction 3 Broca's	55.63 (15.7)	59.25 (15.2)

Table 2: Performance on the *Western Aphasia Battery* (WAB), sound-letter/letter-sound correspondences and real-word reading and spelling for two participants before and after a treatment sequence to maximize phonological skills.

Case Examples	WAB AQ		Sound-Letter		Letter-Sound		Reading		Spelling	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Participant 1	58.7	65.5	30%	100%	55%	85%	2.5%	6.3%	0%	0%
Participant 2	41	45	60%	85%	40%	80%	7.5%	31.3%	1.25%	51.25%*

\*The spelling score for Participant 2 includes his use of an electronic spell checker, which was trained in a phase of treatment not completed by Participant 1. Participant 2's post treatment spelling performance without the use of the spell checker was 23.75%, still a notable improvement over pre-treatment performance.

Figure 1: Treatment sequence for individuals with aphasia and global agraphia.

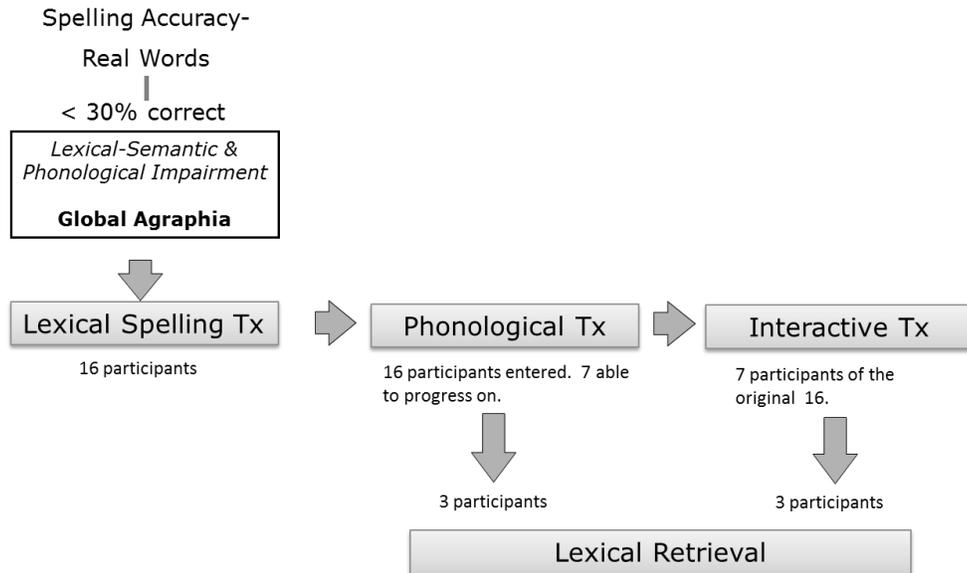


Figure 2: Pre-Treatment spelling performance and pre-post lexical → phonological therapy performance for 9 individuals with global agraphia who had limited response to phonological treatment.

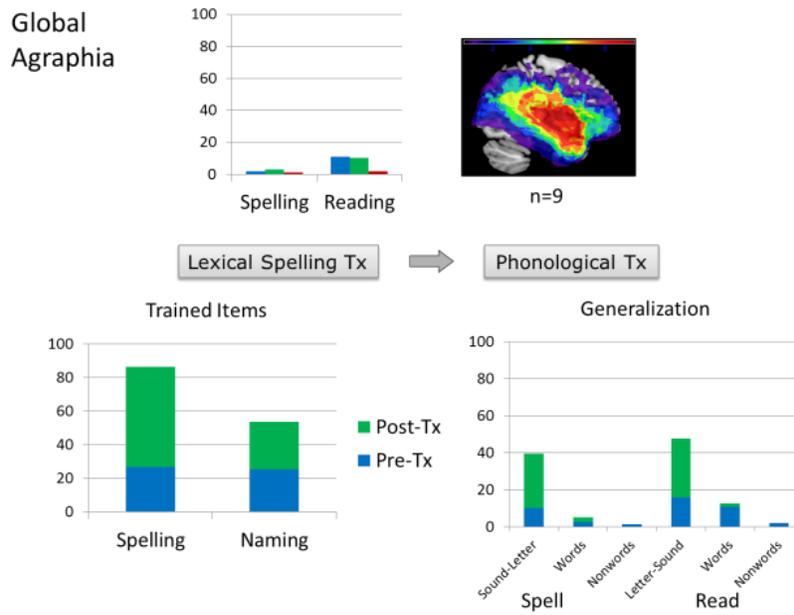


Figure 3: Pre-Treatment spelling performance and pre-post lexical → phonological → interactive therapy performance for 7 individuals with global agraphia who responded well to phonological treatment.

