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Contribution of Phonology and Semantics to Verb Inflection Deficit in Post-Stroke Aphasia

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Introduction

Aphasia can include both phonological (word sound) and semantic (word meaning) impairments (Beeson et al., 2018; Rapcsak et al., 2009). These deficits often co-occur with impaired grammar and verb inflections (Bird et al., 2003; Faroqi-Shah & Thompson, 2003; Thompson, Kielar, & Fix, 2012) and are interdependent, as regular inflection depends on phonological transformations (*press→pressed*), whereas irregular grammar relies more on contributions of semantic relationships between words (i.e., the *past tense of ring is rang not ringed**) (Kielar et al., 2008; Kielar & Joanisse, 2010). **The goal** of the current study is to understand how deficits in the phonology and semantics of language contribute to verb inflection impairment in post-stroke aphasia.

Methods

The participants were 13 individuals (Age: M= 59y, SD =4.9; ED: 16y, SD = 0.8; 8 males, right handed) diagnosed with chronic aphasia (TPO = 6.3y) resulting from left hemisphere stroke and 14 age and education matched healthy controls. **Phonological Skills** were measured using the Arizona Phonological Battery (APB) (Beeson et al., 2016; Rapcsak et al., 2009). **Semantic Knowledge** was assessed using the Camel and Cactus Test (Adlam et al., 2010); the spoken word-to-picture and written word-to-picture matching tasks (PALPA 47 and 48) (Kay et al.,1996), and an auditory synonym judgment test (PALPA 49). Semantic processing specific to verbs was assessed using synonym judgements of verbs (Patterson et al., 2001). Inflection of regular and irregular verbs was assessed using past tense elicitation task with words and pseudowords (e.g., *Susan likes to walk/feep. Yesterday she* __walked/ fept).

In a cross-modal ERP priming task, participants performed a lexical decision on a visual target, e.g., heard “baked” and was visually presented with a word or nonword (e.g., BAKE or SMOB) to make the button-press decision, “Is this a real word or nonword?”

Results

To examine the degree to which phonological and semantic skills predict past tense inflection ability we performed linear regression with past tense scores as the dependent variable and phonological and semantic composites as predictor variables **(Figure 1**). Correlations are in **Table 1**. After accounting for comprehension and production, phonological scores were a significant predictor of regular past tense inflection (b = .736, p =.006) and weak-irregulars scores (b = .625, p = .030). Semantic composite was a significant predictor for all irregulars (b = .639, p = .025) and strong-irregulars, (b =.601, p =

.05). For regularized pseudo-words, phonology emerged as a significant predictor of performance (b = .805, p =.002). Production ability was not a significant predictor of the past tense inflection scores (b=-.474, p = .143) or pseudo-words (b = -.425, p = .133). **Priming effects** (reaction time unrelated-related) for inflected verbs in our ERP experiments are indicative of phonological or semantic deficits in participants with aphasia.

Conclusions

The results indicate that past tense inflection ability for real verbs and pseudo-words can be predicted from the underlying phonological and semantic impairments. Although phonological skills are crucial for both regular and irregular verb inflection, semantic impairment impacts inflection of strong-irregular verbs to a greater degree.

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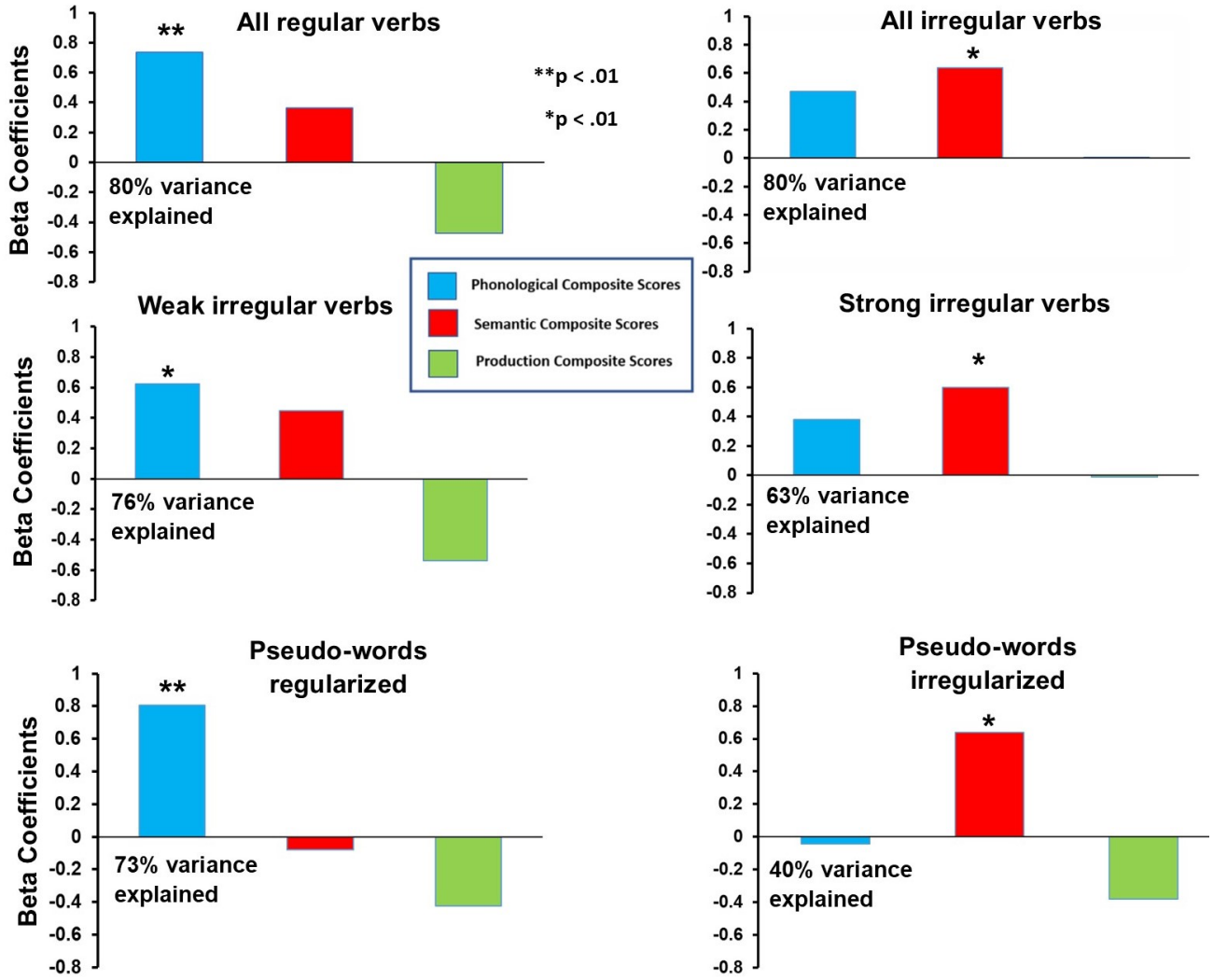

Figure 1. Predicting verb inflection in aphasia from phonological and semantic scores.

Table 1. Relationship between phonological and semantic scores and past tense inflection ability in aphasia. **p < .001, *p < .05

Composite score	regular(walked)	irregular total	weak (slept)	strong irr(sang)
Phonological	**.841****	**.761****	**.724****	**.639***
Semantic	.510	**.597***	.471	**.673***