The role of phonological working memory in phonological alexia

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Introduction

Patients with phonologic alexia show impaired pseudoword (PW) reading, and frequently are impaired in reading functors and words with affixes. Phonological alexia has been attributed to a disturbance in the orthography to phonology reading route. Alternatively, it has been hypothesized that the deficit is one of phonologic processing not specific to reading, consistent with the frequent concomitant impairment in PW repetition (Friedman, 1995).

The purpose of this study was to examine the relationship of one aspect of phonologic processing, phonologic working memory (pWM), to the reading deficit in patients with phonological alexia. Specifically, we hypothesized that the greater the reading impairment, the greater impairment would be seen on a phonologic working memory task. Digit span and spatial span are often used to measure working memory; digit span purportedly measures phonologic working memory, and spatial span measures visuo-spatial working memory. In this study scores on digit and spatial span were compared to scores on word reading, pseudoword reading and pseudoword repetition.

Method

Seven patients with phonologic alexia (mean age 59) were included in the study. Patients were administered the digit and spatial span subtests of the Wechsler Memory Scale III (WMS III; The Psychological Corporation, 1997), and tests of word reading, PW repetition, and PW reading as part of a larger battery of other language and cognitive measures. The word reading test included 41 words from each of five common parts of speech matched for length, syllables, and frequency to the extent possible. Patients viewed one word at a time on a computer screen and were instructed to read the word aloud. The PW repetition test consisted of thirty digitally recorded pseudowords; ten one-syllable, ten three-syllable, and ten five-syllable. Patients heard one pseudoword word at a time through headphones and were instructed to repeat each item. The PW reading test consisted of twenty-one syllable pseudowords of three to four letters in length. Patients were instructed to read each pseudoword aloud. Pearson correlations were calculated comparing the patients' scores on these language measures with scores on the digit span and spatial span tests.

Results

All correlations with digit span were significant \((r = .908, p = .012)\) [word reading], \(r = .97, p < .001\) [PW repetition], \(r = .906, p = .005\) [PW reading]). None of the spatial span correlations were significant. Scatter plots of all significant correlations showed strong linear patterns (Fig. 1).

Summary and discussion

Phonologic working memory, as measured by digit span, was positively correlated with PW reading and PW repetition performance in seven phonological alexic patients. Successful performance on these tasks may depend on the ability to store and subvocally rehearse unfamiliar phoneme sequences within the phonological loop (Baddeley, Gathercole, & Papagno, 1998). Interestingly, pWM was also positively correlated with oral word reading performance in our patients, who showed selective deficits in reading functors and affixed words either in isolation or within text. By contrast, visual working memory, as measured by spatial span, was not correlated with PW repetition, PW reading, or word reading performance in our patients.

Fig. 1. Digit Span and Word Reading.

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The results are consistent with the hypothesis that both the PW reading deficit and the (often seen) functor reading defict of phonological alexia may be caused by an impairment in pWM; neither of these stimulus types has sufficient semantic activation to bolster the phonological activation.

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References