The Role of Phonological Working Memory in Narrative Production: Evidence from Case Series and Case Study Analyses of Chronic Aphasia

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Introduction

Early work showed that semantic, but not phonological, working memory (WM) supports the ability to produce multiword utterances[1,2]. More recently, results from narrative production at the acute stage of stroke corroborated these findings, with multiple regression analyses showing independent contributions for semantic, but not phonological WM, in predicting narrative measures of sentence elaboration [3]. However, the acute stroke results also revealed relations between phonological WM and narrative production: a positive relationship with speech rate, and a negative relationship with proportion pronouns relative to nouns. Two hypotheses have been investigated to explain these relationships: 1) the speed and ease of phonological retrieval at the single word level supports faster speech rate and rehearsal in WM tasks,[3] and 2) the existence of separate input and output phonological WM buffers[4,5], where the output buffer supports fluent speech and phonological WM performance. Follow-up analyses of the acute sample provided support for the phonological retrieval hypothesis; however, input and output buffer capacities could not be distinguished. The current study evaluates these two hypotheses for individuals with chronic aphasia where measures of input and output phonological WM were available.

Method

36 participants were tested on measures of narrative production, semantic WM, single word processing and production, and input and output phonological WM. Output phonological WM tasks require list output (e.g., digit span) whereas input tasks do not (rhyme probe or digit matching span). Participants' narrative production was scored using the Quantitative Production Analysis (QPA)[6].

In a case series analysis, multiple regressions were used to analyze the role of WM and single word measures in predicting speech rate and pronoun use. In a case study analysis. two individuals who showed a distinction between input and output phonological WM capacities, while being matched on other variables, were evaluated for aspects of narrative production.

Results/Discussion

Similar to results for the acute sample, words per minute showed a positive relationship with both input and output phonological WM. However, the multiple regression revealed a role for single word phonological retrieval in predicting words per minute and no independent role for input or output phonological WM, supporting the phonological retrieval hypothesis. Proportion pronouns showed no correlation with output phonological WM and a positive correlation with input phonological WM, opposite that obtained the acute sample. Proportion pronouns in the chronic sample showed extremes in both directions, with some participants producing almost no pronouns and agrammatic speech and one participant producing many pronouns and fluent anomic speech. Neither pattern was observed in the acute sample. These differences meant results for pronoun use were difficult to interpret under both hypotheses. In the case study approach, the output buffer deficit case showed the predicted effects on narrative production with a slower speech rate, increased use of pronouns and increased

phonological errors in production. It may be that both single word phonological retrieval and the output buffer play a role in narrative production but in the case series approach, input and output phonological WM were highly correlated making it difficult to separate their influence.

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