Individual differences between two letter-by-letter readers: impaired letter processing versus impaired verbal working memory

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Pure alexia is a severe peripheral reading impairment which follows lesions to the left fusiform gyrus. It has been argued that the underlying impairment is a visual processing deficit (e.g. Behrmann et al., 1998). This proposal predicts a correlation of deficits at the letter and the word level. Patients with more severe deficits at the letter level should also exhibit poor reading of words and a greater length effect. This prediction was confirmed in several studies (e.g., Sheldon et al., 2012).

In the present study, we compare the performance of two readers with acquired pure alexia, DN and MR. Both had preserved writing and other language skills but severe difficulties reading single words with a significant length effect. Six experiments explored DN and MR’s single letter and word processing.

At the level of single letters and short words, DN’s performance was superior to MR’s. MR was more impaired than DN in processing briefly displayed single letters (Experiment 1; four different intervals, upper and lower case letters; all p’s <0.01). MR was slower than DN in a visual search task (Exp. 2).

When reading words of three, five, and seven letters of length (Exp. 3), DN was faster than MR reading three letter words (t=6.89, p<0.01). However, across all three groups of words, a significant interaction emerged because DN exhibited a greater length effect and was slower in reading seven letter words (F(1,183)=19.76, p<0.01).

Three additional experiments (Exp. 4-6) explored the participants’ deficits further. It could be observed that DN was better able than MR to identify briefly displayed letter triplets but, unlike MR, did not show an advantage when these three letters formed a syllable (cf. Rosazza et al., 2007). If letters of words were presented successively or cumulatively, the patients responded differently (cf. Rosazza et al., 2007): DN exhibited a consistent advantage for the cumulative condition over the successive condition, while MR exhibited an advantage only for the shorter presentation (300 ms) interval but not for the longer (500 ms). This suggests that DN required that letters remained consistently available while MR had a more effective visual buffer. The final experiment employed a self-paced reading with cumulative or moving window display. MR was unaffected by this variation, while DN was better in the cumulative condition.

It is concluded that DN had better preserved single letter processing also facilitating reading of
short words. With longer words, however, DN became increasingly impaired in comparison to MR. It is argued that DN is impaired in his visual-verbal working memory and integration of letters into syllables which affects longer words more. We discuss how this may be modelled in various theoretical accounts of pure alexia and reading.

References

Behrmann et al. (1998). Neuropsychologia, 36 (11), 1115-1132.
