Academy of Aphasia 2012

Word-based Position Representation in Letter Identification: Evidence from Acquired Dyslexia

Schubert T.*, McCloskey M.*

Department of Cognitive Science, Johns Hopkins University

Background

Theories of reading processing have posited three stages of pre-lexical processing: visual features represented in a retina-centered reference frame, letter shapes represented in a stimulus-centered reference frame, and graphemes represented in a word-centered reference frame (Caramazza & Hillis, 1990). This theory does not discuss the reference frame governing letter identification. In this study we investigated the reference frame which defines position at the level of letter identification in word contexts.

Methods and Results

Patient LIID is a right-handed 71-year old female with left occipito-temporal damage. In single-word reading she makes letter substitution errors (e.g., RECKON–>RELIKON), and her responses include significant letter perseverations (McCloskey et al., 2011). Results from several tasks suggest a selective impairment in visual letter identification.

To assess the reference frame implicated in her reading deficit we presented 200 uppercase words in horizontal and inverted orientation (Experiment 1, see Figure 1) in both single-orientation and alternating-orientation (i.e., alternating horizontal and inverted stimuli) blocks. For both inverted and horizontal stimuli LHD's errors primarily affected the last few positions in the word, suggesting that the errors arise in a word-centered reference frame (which represents the letters of a word in their canonical beginning-to-end order regardless of stimulus orientation), rather than a frame that represents the (left-to-right or up-to-down) spatial arrangement of the letters in the stimulus. Perseveration analyses of the alternating horizontal-inverted blocks provide additional evidence for a word-based deficit. Letters perseverated systematically from horizontal to inverted words and vice-versa, and the perseveration errors preserved the position of the source letter as defined by a word-centered but not a stimulus-centered frame of reference (see Figure 1). For example, letters perseverated from the leftmost letter of an inverted word to the rightmost position of the subsequent horizontally-oriented word.

* Corresponding author. Tel.: 4105165036.
E-mail address: schubert@cogsci.jhu.edu.

© 2012 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of The Academy of Aphasia
Open access under CC BY-NC-ND license.
In Experiment 2 we presented 200 uppercase words in vertical orientation (see Figure 1) alternating by trial with words in horizontal orientation. Perseverations were again best explained by a representation of position based on the canonical orientation of the word.

**Discussion**

These results suggest impairment at a level that represents word-based position. As the deficit was independently localized to the process of letter identification, this implies that letters are identified in a position-specific manner. These results suggest that letter identification in words occurs within a word-based frame of reference that abstracts away from stimulus orientation and location. This contrasts with schemes such as the Local Combination Detector (LCD) model, which posits retinocentric location-specific letter detectors computing abstract letter identities (Dehaene et al., 2005).

**References**

