Memory Retrieval and Interference During Language Comprehension: Implications for Embedded Process and Buffer Models of Working Memory

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Recently, general theories of working memory (WM), termed "embedded process models" (e.g., Cowan, 2005), have been put forward that differ substantially from earlier models (e.g., Baddeley, 1986). The embedded process approach discards the notion of buffers for maintaining specific types of information (e.g., phonological or visual-spatial), instead assuming that WM consists of the activated portions of long-term memory (LTM). According to embedded process models, the focus of attention in WM has a very limited capacity. Access to information outside the focus requires a retrieval process in which search cues are used to access, in parallel, items that match these retrieval cues. Similarity-based interference occurs when non-target representations are retrieved that partially match these retrieval cues.

Cue-based parsing models incorporate the assumptions of the embedded process theories into a model of language comprehension (e.g., Lewis, Vasishth, & Van Dyke, 2006). According to this parsing approach, in order to integrate non-adjacent constituents, the word currently in the focus of attention is used to generate cues for retrieving representations of prior information. Interference occurs when other representations provide a partial match to the retrieval cues. For instance, for the sentence "The toy from Sarah arrived," cues generated at "arrived" for retrieving its subject (i.e., syntactic cues – noun, subject; semantic: something that can arrive) will partially match "Sarah" because "Sarah" refers to a noun that can arrive. Comprehension difficulty increases the greater the match to non-target information.

In our lab, we replicated semantic and syntactic interference effects in sentence comprehension for neurally intact subjects and demonstrated exaggerated interference effects in aphasic individuals. Interestingly, however, the degree of semantic interference for both healthy and aphasic individuals related to measures of semantic retention capacity, even after controlling for measures of semantic knowledge. The degree of syntactic interference did not relate to either phonological or semantic capacity, though it did relate to a measure potentially reflecting syntactic retention capacity. Thus, in contrast to the assumptions of the embedded process approach, some notion of capacities specific to different types of information appear to be required, as assumed in buffer models. The buffer approach could be reconciled with the embedded process approach by assuming that activated information outside the focus of attention may decay differentially for different types of information and differentially across individuals. Thus, while the application of the general embedded process approach to sentence processing has led to a new approach to understanding sentence processing, the results from these studies imply that some combination of buffer and embedded process approaches to WM will be required to accommodate the findings.

References

Baddeley, A. D. (1986). *Working Memory*. New York: Oxford University Press.

Cowan, N. (2005). *Working memory capacity*. New York: Psychology Press.

Lewis, R. L., Vasishth, S., & Van Dyke, J. A. (2006). Computational principles of working memory in sentence comprehension. *Trends in Cognitive Science*, *10*, 447-464.