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A neurocognitive perspective on retrieval interference in L2 sentence processing

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Cunnings (Cunnings) offers an interpretation of L2-L1 sentence processing differences in terms of memory principles. We applaud such cross-domain approaches, which seem likely to significantly elucidate the neurocognition of language. Cunnings attributes sentence processing differences between (adult) high proficiency L2 and L1 speakers to an increased susceptibility to similarity-based retrieval interference, rather than to qualitative L2-L1 processing differences (cf. Clahsen & Felser, 2006). On his account, both L1 and L2 sentence processing depend upon a 'bipartite' working memory, which involves maintaining items active by focusing attention on long-term memory representations (Cowan, 2001).

We first discuss Cunnings' account from the perspective of a well-studied neurocognitive model that links language to memory, the declarative/procedural model (Ullman, 2015, 2016). We then consider some issues that moderate our confidence in Cunnings' conclusions.

If we assume Cunnings' account of sentence processing is correct, how might it be interpreted in light of the declarative/procedural model (an interpretation Cunnings' himself remains agnostic about; section 2)? Similar to Cunnings, the declarative/procedural model claims that, in higher proficiency/exposure L2 speakers, rule-governed grammar can be learned and processed in L1 neurocognitive substrates, specifically procedural memory, though at lower proficiency/exposure grammar relies importantly on declarative memory. In contrast, idiosyncratic (non-derivable) information must always be stored (in both L1 and L2) in declarative memory. Declarative memory is closely linked to working memory, which may provide input/output mechanisms for knowledge stored in this system, including lexical information (Ullman, 2016). Thus, sentence processing in both L1 and high proficiency L2 speakers should rely on procedural memory processes for syntactic parsing, and declarative and working memory for the retrieval of information stored in the lexicon.

One of the basic tenets of the declarative/procedural model is that, since language depends on memory systems, principles of those memory systems should apply to language. Thus, consistent with Cunnings' account, factors such as similarity that have been linked to associative long-term (declarative) memory (Mayes, Montaldi & Migo, 2007; Pothos, 2005) should also affect information in the lexicon, including during parsing – especially assuming a 'bipartite' working memory that relies directly on long-term memory. Therefore, any L2-L1 'differences' in similarity-based processing could differentially affect L2-L1 sentence comprehension. Cunnings' account thus appears to be compatible with the declarative/procedural model.

Although we applaud Cunnings' general approach, and believe that it fits with the larger neurocognitive picture, we are cautious about accepting his account at this point. First, we believe that the account requires further specification. What are his claims about lower proficiency L2 learners? What roles do the amount and type of L2 input play? It is also unclear to us whether all L2 studies Cunnings cites as supporting evidence examine high proficiency L2 learners. At a mechanistic level, does Cunnings' claim that retrieval interference in sentence processing is due to attentional mechanisms, long-term memory, both, or something else? Cunnings should also further specify why and how high proficiency L2 learners differ in their similarity-based interference from L1 speakers. Is it just due to transfer? Would he make similar predictions for earlier stage L1 learners, who may follow a similar neurocognitive trajectory to (even adult) L2 learners (Ullman, 2015)? And is similarity-based interference the only likely L2-L1 difference? What other (declarative) memory-based phenomena may play roles, and how might they impact sentence processing? More generally, given his broad assumptions, his model could benefit from further specification of the roles of memory systems in sentence processing, including procedural as well as declarative memory.

Methodological concerns also limit our confidence in Cunnings' conclusions. Much of the cited research uses unusually long, complex sentences (even native-

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speakers often have trouble with them; e.g., examples 3, 9, 10, 11). Not only do these sentences place substantial burdens on working memory (inherently favoring working memory-based parsing accounts, such as Cunnings'), but they also seem likely to engage more explicit cognitive processes that are not necessarily recruited during everyday language use. Thus, it remains unclear whether Cunnings' model holds for shorter, simpler sentences, which it must also explain.

Even if such stimuli reflect general principles of sentence processing, caution is warranted in drawing conclusions from performance measures, which most of his claims rest on. Cunnings appears to assume that L2-L1 similarities in performance suggest common processing mechanisms (e.g., "the existing evidence suggests L2 learners behave similarly to L1 speakers with regards to the role that syntax plays in licensing the initiation of memory retrieval operations during language comprehension", Cunnings). However, this is not necessarily the case. For example, L2 grammar learning under implicit (immersion-like) and explicit (classroom-like) training conditions leads to similar patterns of behavioral performance, but different ERP signatures (Morgan-Short, Steinhauer, Sanz & Ullman, 2012), indicating that different mechanisms can result in similar behavior. Though this caveat is not unique to Cunnings' claims, it underscores the need for appropriate triangulation of methods before drawing conclusions about similarities and differences of underlying mechanisms.

Overall, our concerns might be allayed in various ways. We would like to see Cunnings propose predictions that would allow his account to be directly tested and potentially falsified. In particular, we believe he should lay out predictions that are unique to his account, allowing researchers to distinguish it from that of other competing accounts.

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