Working memory in L2 reading comprehension: The influence of prior knowledge

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ABSTRACT

To distinguish the role of working memory in second language (L2) reading, the present study investigated the influence of readers’ prior knowledge on the contribution of working memory to L2 reading comprehension. Participants were 80 Korean college EFL learners from various academic backgrounds. Two types of reader knowledge (i.e., L2 linguistic knowledge and topic knowledge) were elicited, and a reading span task was used to measure working memory capacity. The results indicated the contribution of working memory to L2 reading comprehension was affected by prior knowledge. Working memory significantly predicted L2 reading comprehension only when the readers had sufficient knowledge, especially knowledge of the topic in the given text. Otherwise, their comprehension performance was mostly determined by their L2 linguistic knowledge, even when they had considerable working memory capacity. It was concluded that the contribution of working memory to L2 reading comprehension can be moderated by readers’ prior knowledge, and that a certain level of knowledge in the target language and on the topic might be required for L2 readers to efficiently utilize their working memory capacity. Theoretical and practical implications were drawn for second language teaching and learning, followed by statements of limitations.

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1. Introduction

Working memory interacts with the process of second language acquisition (SLA). This interaction is believed to occur in the cognitive operations surrounding input and output of a target language, as well as in the problem solving and understanding that takes place while learning (Skehan, 2015). This latter process, understanding, is closely related to comprehension, a critical skill in reading. Literacy development resides in most current models of SLA; however, this field has focused more on working memory in relation to oral interaction than the comprehension of written text. In order to inform instruction and assessment of second language (L2) reading, research is needed to investigate the nuances of second language reading processes, and, specifically, the role of working memory in this modality.

Since Daneman and Carpenter (1980), working memory has been one of the most actively investigated constructs in cognitive psychology of reading with ongoing theoretical discussions of its construct and its exact function in cognitive activities (Wen, 2016). Defined as “the retention of a small amount of information in a readily accessible form to be used in cognitive tasks” (Cowan, 2014: p.197), working memory (hereafter WM) holds information gathered from long-term memory
and connects it to new information (Cain, Oakhill, & Bryant, 2004), thus conceived of as a prerequisite for processing textural coherence.

Studies of WM in L2 contexts have been steady over the past two decades, often yielding results that confirm the substantial contribution of WM to second language learning and reading (e.g., Alptekin & Erçetin, 2009, 2010, 2015; Gass & Lee, 2011; Harrington & Sawyer, 1992; Rai, Loschky, Harris, Peck, & Cook, 2011). However, discrepancies also emerge. Some researchers maintain that the importance of WM in L2 processing had been rather overestimated (Juffs & Harrington, 2011; Juffs, 2005; Williams, 2011). In an in-depth review of WM studies conducted in L2 contexts, Linck, Osthus, Koeth, and Bunting (2014) called for further studies elucidating the precise nature of WM’s role in L2 development. They pointed to areas requiring further investigation: (1) the specific subcomponents of WM that affect aspects of L2 processing and learning, and (2) possible factors that moderate the relationship between WM and L2 outcomes. Further exploration seems necessary, therefore, about the exact nature of WM’s role in L2 processing to explore in what manner WM works for efficient L2 reading comprehension and whether and how WM interacts with other powerful predictors such as background and target language knowledge.

A significant body of research has provided evidence for the positive influence of WM on a variety of cognitive processes for both young and adult readers in their first language (e.g. Joseph, Bremner, Liverdedge, & Nation, 2015; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000; de Beni, Palladino, Pazzaglia, & Cornoldi, 1998). Furthermore, some consensus has formed that WM plays a significant role in first language reading comprehension independent of foundational reading skills such as decoding or word recognition (Baddeley, Logie, Nimmo-smith, & Brereten, 1985; Cain et al., 2004; Daneman & Merikle, 1996). On the other hand, other scholars have warned against relying on WM as a powerful predictor of higher-order reading skills, such as comprehension ability (Booth, Boyle, & Kelly, 2014; Van Dyke, Johns & Kukona, 2014).

Recognizing that reading in a second language differs from reading in the first, the question arises of whether or not L2 proficiency moderates the role of WM in L2 processing. Previous studies have yielded mixed results (Payne, Kalibatseva, & Jungers, 2009; Swanson, Orocos, Lussier, Gerber, & Guzman-Orth, 2011; Walter, 2004). For example, Linck et al. (2014) reported little difference overall between less- and more-proficient learners in the correlation between WM and L2 learning outcomes. In addition, the interrelationships among WM, background knowledge, and language processing have not been agreed upon (Alptekin & Erçetin, 2011; Leeser, 2007). Given these gaps in research on WM and L2 reading comprehension, the current study explores how WM’s contribution to L2 reading comprehension is related to readers’ prior knowledge.

2. Literature review

Daneman and Hannon (2007) described WM as an integral part of language comprehension that affects the ability to remember new information acquired while reading. It allows one to simultaneously make inferences about the new information and access knowledge from long-term memory to integrate with the new information. Some researchers have cited WM as a critical element of L2 aptitude related to L2 proficiency outcomes (DeKeyser & Koeth, 2011; Miyake & Friedman, 1998; Skehan, 2015), emphasizing the role of WM in successful L2 performance. Given these descriptions, it seems natural that researchers turn to the role of WM in L2 comprehension in their pursuit of an explanatory model of L2 reading. This section will review research on WM in SLA then narrow to studies on the relationship between WM, prior knowledge, and L2 reading.

2.1. Working memory in L2 acquisition

Skehan (2015) stated that WM should have a major impact on language acquisition and processing, since WM is “a buffer for language input and output” as well as “a working place for the solution of problems” in input and output processing (p.189). Juffs (2015) also paid attention to WM as a possible explanation for individual differences in L2 learning. He further mentioned it would have “pedagogical implications” (p.125) for SLA researchers if the effects of WM on L2 learning are confirmed.

WM studies in L2 contexts have focused on whether and how WM is involved in the acquisition or processing of L2 grammar and vocabulary (Denhovska, Serratrice & Payne, 2016; Mackey & Sachs, 2012; Martin & Ellis, 2012). SLA researchers have also explored the exact nature of WM in L2 development, processing, and comprehension by examining the possible interaction of WM capacity with other variables such as input modality (Kozan, Erçetin, & Richardson, 2015; Walker & Redick, 2016), feedback type (Li, 2013; Révesz, 2012; Yilmaz, 2013), and manner of learning (Denhovska et al., 2016). Several previous studies have suggested that WM’s effect on L2 processing might depend on the proficiency level of the participants and the L2 structures examined (Dussias & Pinar, 2010; Havik, Roberts, Hout, Schreuder, & Haverkort, 2009; Hopp, 2014; Sagarra & Herschensohn, 2010).

While a considerable body of recent WM studies focus on the acquisition/learning of words, morphemes, or syntactic rules in L2, relatively small number of studies have examined the role of WM in relation to reading comprehension beyond the sentence level. More studies are necessary that directly involve language learners reading L2 texts and that attend to discourse comprehension, which is cognitively more demanding than sentence processing. Studying WM at the discourse level, therefore, will help verify whether WM’s effect on sentential processing is generalizable to discourse comprehension.

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1 Wen's (2016) meta-analysis of L2 WM studies since 1990’s revealed, that the number of published studies on the relationship between WM and L2 reading comprehension is less than a quarter of those on WM in acquiring L2 grammar and vocabulary.
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