



Interactions between reader and text: Contributions of cognitive processes, strategy use, and text cohesion to comprehension of expository science text[☆]



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ABSTRACT

Emerging evidence suggests that characteristics of text demonstrate differential recruitment of specific cognitive processes involved in reading comprehension. The aim of this study was to examine the relations among important reader and text characteristics and their contributions to comprehension of expository science text. Specifically, we examined whether text that varied in referential cohesion required differential use of specific executive functions, metacognitive monitoring of performance, and strategy use among adult readers. The results indicated that shifting, but not updating or inhibition, differentially predicted comprehension of text that was lower in referential cohesion, while updating, but not inhibition or shifting, predicted comprehension of text that was higher in referential cohesion. Metacognitive monitoring and reading strategy use predicted comprehension independent of the level of referential cohesion of text. The findings provide additional evidence for the important and interactive roles of key reader and text characteristics in understanding of expository text, and suggest important areas of future study.

1. Introduction

Comprehension of expository text is a dynamic and complex process, and is critical for success in today's society. Many college learners and adults, however, struggle with expository text comprehension based on factors such as complexity of the text's content and increased demands imposed on readers' prior knowledge (Best, Rowe, Ozuru, & McNamara, 2005; Kendeou & van den Broek, 2007; Lei, Rhinehart, Howard, & Cho, 2010). Factors and processes such as the integration of textual information with prior knowledge, the use of inferencing, and the use of strategies during reading have been shown to contribute significantly to comprehension of expository text (e.g., Best et al., 2005). Despite considerable theoretical and empirical interest in examining processes that underlie reading comprehension (e.g., Cutting & Scarborough, 2006; Duke & Carlisle, 2011; Hoover & Gough, 1990; Kintsch, 1988; van den Broek & Helder, 2017), much less research has examined individual differences in readers' use of specific executive and metacognitive processes and their contributions to comprehension of expository text (see Follmer, 2018 and van den Broek, 2010 for reviews).

Emerging research suggests that characteristics of text (e.g., text

type, complexity), impose different demands on higher-order cognitive processes involved in the comprehension of text (Eason, Goldberg, Young, Geist, & Cutting, 2012; Miller et al., 2014). Existing work, however, has not yet presented an examination of the effect of text cohesion on the links among cognitive and metacognitive processes and reading comprehension. The primary aim of this study was to examine whether text that varied in referential cohesion required differential use of the executive functions of inhibition, shifting, and updating, metacognitive monitoring, and strategy use. In doing so, we aimed to present an examination of reader-text interactions and how such interactions predict learning from expository text (Bohn-Gettler & Kendeou, 2014).

1.1. Expository text comprehension

Reading comprehension, or the ability to obtain meaning and learn from written text (Best et al., 2005; Vellutino, 2003), is a critical skill (McCrudden, Magliano, & Schraw, 2011; Pressley, 2006; Pressley & Afflerbach, 1995). The ability to comprehend expository text (i.e., informational text) is believed to draw on a host of processes that work together to aid the reader in constructing a coherent and accurate representation of text, including processing speed, vocabulary ability,

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fluency, and decoding skill (Best et al., 2005; Cutting, Materek, Cole, Levine, & Mahone, 2009; Meyer & Rice, 1989; Rice & Meyer, 1985). Successful comprehension requires readers to meaningfully integrate information across sentences to achieve a global, text-level understanding (Best et al., 2005; Kintsch, 1988; McNamara & Kintsch, 1996). Likewise, information presented in and meaning obtained from text must be incorporated with readers' prior knowledge. Accordingly, individual ideas and concepts presented in expository text need to be connected by meaningful relations (van den Broek, 2010). As readers engage with text, learning is achieved by the generation of inferences and the modification of readers' existing knowledge to accommodate new concepts presented in text (Best et al., 2005).

A number of comprehension models delineate the features of and processes involved in comprehension as well as extratextual factors (e.g., goals, motivational variables) that contribute to comprehension among readers (McNamara & Magliano, 2009). The current work is based theoretically on the construction-integration (Kintsch, 1988, 1998), structure-building (Gernsbacher, 1990; Gernsbacher, 1991), and landscape (van den Broek, 2010; van den Broek, Young, Tzeng, & Linderholm, 1999) models of comprehension, as these models acknowledge the importance of referential cohesion and knowledge-based inferencing in understanding of text (McNamara & Magliano, 2009) as well as the roles of processes such as shifting and suppression (i.e., inhibition) in text comprehension. While these and other comprehension models (e.g., Gernsbacher, 1997) diverge on exactly how specific processes contribute to comprehension, central to these models is the idea that readers' attentional and memory resources are limited, and that these limitations affect how readers engage with and process text (McNamara & Magliano, 2009).

1.2. Executive function and reading comprehension

A developing body of literature has also examined the relationship between executive function and reading comprehension among varied learners (Follmer, 2018). Executive function describes a set of neurocognitive processes involved in the deployment of behavior that is goal-directed (Anderson, 2002; Denckla, 1996; Eslinger, 1996). The current research is based on a conceptualization of executive functions as independent but related cognitive processes engaged during challenging situations that coordinate cognitive functioning and behavior in service of a future goal (Follmer & Sperling, 2016; Welsh, Friedman, & Spieker, 2006). Importantly, executive function reflects a construct that has been difficult to define and measure (e.g., Snyder, Miyake, & Hankin, 2015). Further, there exist a multitude of measures that aim to tap specific executive functions which are often complex in nature and depend additionally on a host of non-executive processes (see the task impurity problem; Miyake & Friedman, 2012). While existing work has not yet reached consensus on a unifying model of executive functions, research generally supports the roles of inhibition, shifting, and updating as core executive functions contributing to goal-directed behavior (Blair, 2016). These executive functions describe the abilities to suppress a prepotent response in favor of a subdominant response, switch flexibly between mental sets, and monitor, maintain, and manipulate information in memory. Such functions have been linked to academic and cognitive outcomes, including word reading and writing (e.g., Christopher et al., 2012; Fuhs, Farran, & Nesbitt, 2015).

Executive function has been shown to contribute to comprehension of text above and beyond processes commonly ascribed to comprehension, including word reading and phonological processing (e.g., Carretti, Borella, Cornoldi, & De Beni, 2009; Locascio, Mahone, Eason, & Cutting, 2010). Kieffer, Vukovic, and Berry (2013), for example, found that inhibition predicted comprehension of narrative and expository text among a sample of low income elementary aged learners after controlling for word reading, working memory, and processing speed. In another study, Borella, Carretti, and Pelegrina (2010) examined inhibition among good and poor readers, and found that poor

readers demonstrated marked difficulty with interference control (i.e., maintaining and controlling the relevance of information during reading). Similarly, Arrington, Kulesz, Francis, Fletcher, and Barnes (2014) found significant contributions of inhibition to comprehension above and beyond processes considered necessary for reading (Chen & Vellutino, 1997; Gough & Tunmer, 1986). This research and others (e.g., Cutting et al., 2009; Sesma, Mahone, Levine, Eason, & Cutting, 2009) suggests an important role of inhibition in the ability to suppress information not textually relevant during reading.

Existing empirical work has demonstrated the importance of shifting in comprehension. For example, cognitive flexibility has been shown to uniquely predict reading comprehension above and beyond the predictors of age, vocabulary, decoding, and socioeconomic status (Guajardo and Cartwright 2016) and contributed significantly to reading comprehension among adolescent readers (Latzman, Elkovitch, Young, & Clark, 2010). Kieffer et al. (2013) also suggested that shifting may facilitate readers' flexible use of strategies that require the shifting of attention during reading, including skimming, rereading, and information searching. Such evidence suggests that shifting affords readers the ability to form new concepts during reading as well as consider multiple and differing perspectives.

Iglesias-Sarmiento, L Opez, and Rodriguez (2015) obtained evidence that updating facilitates readers' text processing such that information relevant to understanding the text can be maintained. In other studies (e.g., Borella et al., 2010), skilled readers demonstrated higher performance on updating tasks than struggling readers. These studies and others (Miller et al., 2013; Pelegrina, Capodieci, Carretti, & Cornoldi, 2015; Swanson, 2003) indicate that updating facilitates readers' ability to maintain relevant text-based information in memory.

1.3. Strategy use, metacognitive monitoring, and reading comprehension

Learners' use of strategies is an important determinant of effective self-regulation (Cleary, Callan, Malatesta, & Adams, 2015; Zimmerman, 2008). In the context of reading comprehension, the use of strategies, enacted appropriately, facilitates readers' ability to construct and maintain a coherent representation of text (Borkowski, Weyhing, & Carr, 1988; Kletzien, 1991; Lorch, Lorch, & Klusewitz, 1993; Pressley & Afflerbach, 1995). Examples of such strategies include previewing, skimming, selection strategies such as underlining and circling, re-reading, notetaking, integrating visual representations with text, adjusting reading speed based on perceived, real-time textual understanding, and paraphrasing and summarizing (e.g., Mokhtari & Reichard, 2002). In the area of expository text, processes such as selecting relevant information from text, organizing selected information into a coherent representation, integrating textual information with prior knowledge, and generating accurate inferences across concepts are critical in promoting comprehension (Kendeou & van den Broek, 2007; Mayer, 1996; McNamara & Kintsch, 1996; van den Broek, 2010). In short, the appropriate use of reading strategies effectively aids comprehension by generating inferences that "repair conceptual gaps between clauses, sentences, and paraphrases" (Best et al., 2005, p. 70). Further, skilled readers are better able to employ reading strategies conditionally, thus leveraging effective monitoring and inference-making to improve comprehension (Best et al., 2005; McNamara & Scott, 1999; Pressley & Afflerbach, 1995).

Previous research has also supported the role of metacognition (Brown, 1978) and metacognitive monitoring in learners' studying and effective use of strategies during reading (e.g., Collins, Dickson, Simmons, & Kameemui, 2005; Fukaya, 2013; Huff & Nietfeld, 2009; Krebs & Roebbers, 2012; Thiede, Anderson, & Theriault, 2003). Metacognitive monitoring informs a reader's evaluation of comprehension as well as what strategies need to be employed (and when) to improve comprehension in real time. Learners who monitor effectively – whether during reading or during testing – are believed to be better able to estimate the accuracy of their comprehension and to adjust strategy use

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