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Translating advances in reading comprehension research to educational practice

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Abstract

The authors review five major findings in reading comprehension and their implications for educational practice. First, research suggests that comprehension skills are separable from decoding processes and important at early ages, suggesting that comprehension skills should be targeted early, even before the child learns to read. Second, there is an important distinction between reading processes and products, as well as their causal relationship: processes lead to certain products. Hence, instructional approaches and strategies focusing on processes are needed to improve students' reading performance (i.e., product). Third, inferences are a crucial component of skilled comprehension. Hence, children need scaffolding and remediation to learn to generate inferences, even when they know little about the text topic. Fourth, comprehension depends on a complex interaction between the reader, the characteristics of the text, and the instructional task, highlighting the need for careful selection of instructional materials for individual students and specific groups of students. Finally, educators may benefit from heightened awareness of the limitations and inadequacies of standardized reading comprehension assessments, as well as the multidimensionality of comprehension to better understand their students' particular strengths and weaknesses.

Keywords: Reading comprehension research, education practice, instructional implications

Introduction

Translating Advances in Reading Comprehension Research to Educational Practice

An extensive and impressive knowledge base has been established in the area of reading comprehension (for reviews, see McNamara & Magliano, 2009; RAND Reading Study Group, 2002). In the present paper, our aim is to discuss important findings in reading

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comprehension research and particularly those findings that we deemed to have the potential to impact educational practice but have yet to be fully utilized. These findings are:

- Dissociations between decoding and comprehension skills
- Distinctions between the process and the product of reading comprehension
- The importance of prior knowledge to inferencing
- Interdependencies among reader and text characteristics
- Inadequacies of commonly used reading comprehension assessments

In the first section of the paper, we briefly summarize the findings for each of these advances in reading comprehension research. In the second section, we translate these advances into concrete recommendations for educational practice. In the final section, we discuss future directions for reading comprehension research.

What do we know about reading comprehension?
Comprehension versus Decoding

A prominent advance in reading comprehension research concerns the relation between decoding and comprehension skills. Many researchers have focused on the initial stages of reading acquisition, highlighting the importance of decoding skills - skills that support reading, such as phonological awareness, letter and word identification (for reviews, Snowling & Hulme, 2005; Storch & Whitehurst, 2002), and comprehension skills - skills that support oral language comprehension, such as receptive vocabulary and listening comprehension (e.g., Kendeou, van den Broek, White, & Lynch, 2009; Lonigan, Burgess, & Anthony, 2000).

The relation between these two sets of skills is expressed most succinctly within the Simple View of Reading (Gough, Hoover, Petersen, 1996; Gough & Tunmer, 1986). In the SVR, reading comprehension is described as the product of a reader's word decoding and listening comprehension skills, with the central tenet that both decoding and comprehension are necessary for reading comprehension. Notably, advocates of the SVR model do not discount other potential contributors to the reading process, but rather propose that decoding and comprehension are the core competencies (Kendeou, Savage, & van den Broek, 2009).

In principle, if decoding and comprehension are separate dimensions of reading comprehension, then each should depend on different underlying skills and abilities and children can perform differentially on these two sets of skills. Indeed, research on poor readers has identified children with good decoding but poor comprehension skills (Cain, Oakhill, & Lemmon, 2005; Nation, 2005; Stothard & Hulme, 1992) as well as children with poor decoding but good comprehension skills (Adlof, Catts, & Little, 2006; Spooner, Baddeley, & Gathercole, 2004).

In addition, several studies on the development of decoding and comprehension skills have suggested their dissociation (Cutting & Scarborough, 2006; Kendeou, van den Broek, White, & Lynch, 2007; Kendeou et al., 2005, 2009; Muter, Hulme, Snowling, & Stevenson, 2004). There is convincing evidence that these sets of skills are separate and relatively unrelated from preschool to early elementary school (Catts, Fey, Zhang, & Tomblin, 1999; Cain, Oakhill, & Bryant, 2004; Kendeou et al., 2005, 2007, 2009; Savage, 2006), and both set of skills significantly, and independently contribute to reading comprehension performance in early elementary school (Kendeou et al., 2009; Storch & Whitehurst, 2002).

Process versus Product of Reading Comprehension

Reading comprehension research has produced detailed and valuable information regarding the development of reading comprehension skills and the factors that influence and are influenced by these skills (McNamara & Magliano, 2009). Although there are many definitions of what constitutes successful reading comprehension, a common component of most definitions is that it involves the construction of a coherent mental representation of the text in readers' memory. This mental representation is the product of reading comprehension. Its construction, however, is the *process* of comprehension and occurs moment-by-moment as the individuals read. Distinguishing between products and processes is important because the two are causally related: Reading processes lead to reading products (Kintsch, 1988; Trabasso & Suh, 1993). Most important, failures in particular processes can lead to comprehension difficulties, and by consequence, low performance in terms of its products.

In reading comprehension research, a focus solely on products limits our ability to identify underlying mechanisms that may lead to changes in reading performance (Magliano, Millis, Ozuru, & McNamara, 2007). A focus solely on processes limits our ability to determine potential impacts of textual, reader, and task factors on reading performance. By considering both processes and products, researchers provide increased rigor in the investigation of various issues, as well as a deeper understanding of how to best facilitate reading comprehension. Importantly, by knowing at which points and why the process fails, we can design appropriate interventions and learning materials to prevent or remediate the problem.

Inferencing and Prior Knowledge

Another major advance in reading comprehension research concerns the central role of inference processes and the role of prior knowledge in these processes. Indeed, the ability to draw inferences is central to reading comprehension across the lifespan (Oakhill, Cain, & Bryant, 2003; Paris, Lindauer, & Cox, 1977; van den Broek, 1990), and there is direct evidence that it is not just a by-product of comprehension, but rather a plausible cause (Cain & Oakhill, 1999).

In the context of reading comprehension, *inferencing* is the process of connecting information within the text or within the text and one's knowledge base, and drawing a conclusion that is not explicitly stated in the text. One type of inference, called bridging inferences, connects current text information to information that was previously encountered in the text, such as connecting the current sentence to a previous sentence. Another type, associative inferences or elaborations, connects current text information to knowledge that is not in the text. For such knowledge-based inferences, readers bring knowledge that is related to the text to the focus of attention, and in doing so, construct connections between the text and prior knowledge (Cook, Limber, & O'Brien, 2001). Of course, a reader continuously draws upon knowledge with every word encountered in a text. Each word requires accessing memory to process its meaning. Prior knowledge of both the words in the text and related concepts are activated or *primed* (O'Brien & Myers, 1999). When comprehenders have more knowledge about the domain, or about the world, then their understanding of a text or discourse is likely to be richer and more coherent because more concepts that are not explicit in the text are available to the reader and become part of the reader's mental representation of the text.

Consequently, readers' prior knowledge directly influences readers' ability to generate inferences. Readers who have more knowledge about the topic of a text better understand the written material (Chiesi, Spilich, & Voss, 1979; Haenggi & Perfetti, 1994) and are better able to comprehend texts that require numerous inferences (McNamara, 2001; O'Reilly &

McNamara, 2002). These advantages partially arise because high knowledge readers answer comprehension questions based on prior knowledge, rather than information in the text and are more likely to generate inferences that connect new information in the text with prior knowledge.

Knowledge helps a reader to make inferences. In addition, the reader also needs to know how to make inferences. Behavioral studies of individual differences in comprehension indicate that skilled and less-skilled readers differ primarily in terms of inference processes such as solving anaphoric reference, selecting the meaning of homographs, processing garden-path sentences, and making appropriate inferences while reading (Long, Oppy, & Seely, 1994; Oakhill, 1984; Oakhill & Yuill, 1996; Singer & Ritchot, 1996; Whitney, Ritchie, & Clark, 1991; Yuill & Oakhill, 1988). Protocol analyses have further revealed that skilled readers are also more likely to generate inferences that repair conceptual gaps between clauses, sentences, and paragraphs (Magliano & Millis, 2003; Magliano, Wiemer-Hastings, Millis, Muñoz, & McNamara, 2002). In contrast, less skilled readers tend to ignore conceptual gaps in text while reading and often fail to make the inferences necessary to fill in the gaps (Garnham, Oakhill, & Johnson-Laird, 1982; Oakhill, Yuill, & Donaldson, 1990).

Reader-Text Interactions

There are innumerable factors affecting reading comprehension, such as reader characteristics, text properties, and the instructional context in which reading takes place (Dixon & Bortolussi, 1996; RAND Reading Study Group, 2002; Stanovich & Cunningham, 1993; van den Broek & Kremer, 1999). Although these factors have often been studied in isolation, a consideration of their interactions and interdependencies provides crucial information about the comprehension process (Kintsch, 1998; RAND Reading Study Group, 2002).

Among text characteristics, text cohesion is an important aspect of text that influences reading comprehension processes. Cohesion arises from a variety of sources, including explicit referential overlap and causal relationships (Givón, 1995; Graesser, McNamara, & Louwerse, 2003). Referential cohesion, for example, refers to the degree to which there is overlap or repetition of words or concepts across sentences, paragraphs, or the entire text. McNamara, Kintsch, Songer, and Kintsch (1996) found that *the effects of text cohesion and reader prior knowledge interact* (O'Reilly & McNamara, 2007a; Ozuru, Dempsey, & McNamara, 2009). These studies show that low-knowledge readers benefit from added textual cohesion because they lack the necessary knowledge to generate inferences. By contrast, high-knowledge readers (i.e., who do not generate strategic inferences; O'Reilly & McNamara, 2007a) benefit from cohesion gaps in the text because they are induced by the gaps to generate inferences.

Other investigators have similarly demonstrated that comprehension is enhanced when readers are induced by the text to generate inferences and these inferences are successful (Einstein, McDaniel, Owen, & Cote, 1990; Mannes & Kintsch, 1987; O'Brien & Myers, 1985; Rauenbusch & Bereiter, 1991). The theoretical explanation for these findings rests on the assumption that comprehension is largely determined by the coherence of the reader's mental representation of the text, and this is a function of both the ease of processing the text and the inferences generated by the reader. As illustrated in Figure 1, McNamara and Magliano (2009) proposed that reading comprehension will tend to be best when the ease of processing is high and the reader is strategic (quadrant A), and worse when the ease of processing is low and the reader is not strategic (quadrant D). Comprehension will tend to be more superficial and thematic in quadrant B, and will tend to be limited more to a textbase level understanding (i.e., a representation that primarily reflects the explicit content presented in the text) in quadrant C.

Of course, these comprehension outcomes are a function of numerous other interdependent factors that influence reading. For example, the ease of processing a text can depend on the familiarity of the words, the complexity of the domain, text readability, text cohesion, text domain or genre, and a many other factors, some of which depend on each other producing complex interactions. Similarly, the likelihood that a reader will engage in strategic comprehension processes can depend on reading skill, comprehension skill, motivation, metacognitive awareness, domain knowledge, reading strategy knowledge, goals, and tasks, which in turn can interact, not only with one another but with characteristics of the text. Thus, the causes vary for a text being more or less facile to understand and for a comprehender to be more or less strategic. Nonetheless, narrowing the focus on these two overarching factors (i.e., text ease, strategic processing) provides a heuristic for better understanding the scope of comprehension outcomes across studies and situations.

Assessment of Reading Comprehension

The assessment of reading comprehension has been one of the most controversial issues in the field (Keenan, in press; Kendeou & Papadopoulos, in press) for several reasons. First, the assessment typically focuses on the product of reading and provides little or no information with respect to the actual processes (Magliano et al., 2007; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). Second, it is the complex interaction of many factors, such as types of texts and response formats that influences students' performance (Ozuru, Rowe, O'Reilly, & McNamara, 2008; Paris, 2007). Third, current assessments confound comprehension with vocabulary, prior knowledge, word decoding, and other reader abilities involved in comprehension. Finally, well-known tests of reading comprehension have been criticized for lacking content and concurrent validity (Keenan & Betjemann, 2006) and for differential dependencies on decoding and comprehension skills (Keenan, Betjemann, & Olson, 2008). These controversial issues highlight that the measurement of the construct is not a trivial task.

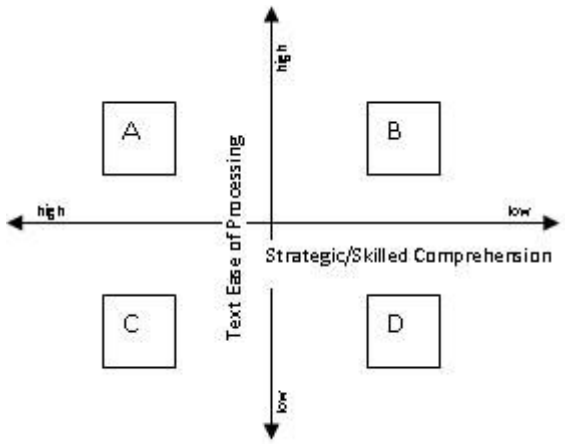

Figure 1. *Four quadrants crossing text ease and reader abilities (reprinted from McNamara & Magliano, 2009).*

On the one hand, the assessment of reading comprehension in research studies has often been theory-based and guided by comprehension models such as Kintsch and van dijk's (1978; Kintsch, 1998), which propose that there are multidimensional levels of understanding

that emerge during the comprehension process, including surface, textbase, and situation model levels (McNamara & Magliano, 2009). By consequence, in order to obtain a full picture of a reader's understanding, assessment needs to consider the full range of these potential levels of comprehension. Although comprehension is assumed to be one interconnected mental representation, different types of assessments pull out different levels of understanding. For example, multiple-choice questions that target a restricted range of text (e.g., a single sentence or consecutive sentences) tend to provide an indication of the degree to which the reader can recognize the information from the text, usually at superficial level (Keenan et al., 2008). Cloze tasks that require readers to fill in missing words in text (e.g., Woodcock-Johnson Test) assess comprehension only within sentences based on word associations (Shanahan, Kamil, & Tobin, 1982). At the other extreme, asking the reader to use the information in the text to solve a problem taps into the reader's deeper, situation model understanding of the text (McNamara et al., 1996).

Translating what we know to educational practice

We know a good deal more about comprehension than what could be presented in this paper (RAND Reading Study Group, 2002). This summary has presented a subset of what may be considered the most important findings regarding comprehension, and particularly those findings that may potentially have the most impact on educational practice. These findings can be translated into concrete recommendations for educational practice geared towards improving students' ability to understand and learn from text:

- Give early focus to comprehension skills
- Design interventions that influence the actual comprehension process
- Teach students to make inferences, even without prior knowledge
- Consider during instruction not only the reader and the text, but also their respective interaction
- Interpret student reading performance by considering the test used

Give early focus to comprehension skills

The literature on the relation between decoding and comprehension skills, and the contribution of those skills to later reading comprehension, highlights the importance of developing these skills in young children. These findings imply that both decoding and comprehension skills should be targeted well before the child can read fluently (Kendeou et al., 2007, 2009). Although much attention in preschool language programs has been devoted to basic language skills that support decoding, attention to comprehension skills is equally important and needs to be included in such programs.

Activities situated around television viewing or aural listening may provide the opportunity for developing comprehension skills that could later transfer to reading (Kendeou et al., 2005, 2007, 2009; van den Broek, Rapp, & Kendeou, 2005). The use of television or aural stories offers several advantages over the use of printed text alone for young children because they are highly motivating and can easily be used with a large group of children in school as well as non-school (e.g., home) settings. The use of these non-written media provides a unique opportunity for children to be taught comprehension strategies that are not completely dependent upon verbal skills. Also, well-known reading comprehension instructional programs such as Reciprocal Teaching (Palincsar & Brown, 1984) and Peer Assisted Learning Strategies (PALS; Fuchs, Fuchs, Mathes, & Simmons, 1997) can be modified and used to foster comprehension development even at preschool age.

Design interventions that influence the actual comprehension process

The review on the distinction between process and product of reading comprehension highlights that the product of reading is directly influenced by the processes that take place during reading (Kintsch, 1998; Trabasso & Suh, 1993; van den Broek et al., 2005). This finding implies that for teachers to be able to affect the product of reading (e.g., increase reading performance), they need to implement appropriate interventions and instructional approaches to affect the actual processes *during* reading.

Indeed, a wide array of strategy interventions that have been shown to be effective in elementary school instruction share this characteristic: *they influence the actual processes while reading unfolds* (McNamara, 2007; Pressley, 1998, 2000). For instance, some interventions emphasize the importance of asking questions during reading (King, 2007). Other methods have used group activities to help students learn to make connections while listening or reading (Palincsar & Brown, 1984; Fuchs & Fuchs, 2007; Yuill, 2007). Numerous activities can be used (in reading and non-reading contexts) to help students learn how to make connections and, as a result, construct better mental representations of the texts, including: reading and thinking-aloud activities, question asking, and paragraph summarization (Kendeou et al., 2007).

Teach students to make inferences, even without prior knowledge

The review on the central role of inferences in reading comprehension highlights the need for teachers to scaffold these skills to students of all ages, so they learn to generate inferences that connect ideas in the text, bring in prior knowledge, and construct connections using general knowledge, despite a lack of sufficient domain specific knowledge. iSTART is a computer-based technology that focuses on providing high school and college students with instruction and practice using reading comprehension strategies that compensate for knowledge deficits (McNamara, Boonthum, Levinstein, & Millis, 2007). Its design is based on a classroom intervention called Self-Explanation Reading Training (SERT; McNamara, 2004) that combines self-explanation (Chi et al., 1994) with reading comprehension strategies (Bereiter & Bird; 1985; Palincsar & Brown, 1984). Students learn to self-explain using five reading strategies: *monitoring comprehension*, *paraphrasing*, making *bridging inferences* between the current sentence and prior text, making *predictions*, and *elaborating* the text with links to what the reader already knows. Studies evaluating iSTART's impact indicate that both strategy use and comprehension are enhanced (McNamara et al., 2007). However, the locus of the effect depends on the student's prior abilities. Low knowledge, less skilled students benefit most at the textbase level of comprehension, whereas high-knowledge, more skilled students show the largest gains on deep level questions (Magliano et al.,2007; McNamara et al., 2006; O'Reilly, Best, & McNamara, 2004). Thus, students benefit from reading strategy training at their zone of proximal development.

When teachers employ interventions that target more active or strategic use of knowledge, students' reading skill and comprehension can be dramatically improved (Bereiter & Bird, 1985; Chi, de Leeuw, Chiu, & LaVancher, 1994; Cornoldi & Oakhill, 1996; Dewitz, Carr, & Patberg, 1987; Hansen & Pearson; 1983; Kucan & Beck, 1997; McNamara, 2004; Palincsar & Brown, 1984; Paris, Cross, & Lipson, 1984; Yuill & Oakhill, 1988). In essence, with strategy interventions (e.g., SERT) teachers assist students to learn *how* and *when* to make inferences. Such training could be achieved in a classroom, for example, by asking students in pairs to take turns self-explaining a portion of the textbook or having students explain as a class while maintaining a continuum. If students use and practice the strategies, the potential benefit to their performance is substantial.

Consider during instruction not only the reader and the text, but also their respective interaction

The review on the interactions and interdependencies between readers and texts highlights the complexity of reading comprehension and the need for careful selection of instructional materials for individual students and specific groups of students. Students may benefit simply from educators' heightened awareness of the complexity of factors that can influence comprehension as well as a better understanding of the importance of choosing the right texts for the right students. Optimally, students need to be provided with texts that they can understand.

Considering Figure 1, if educators choose relatively easy-to-read texts and their students are highly motivated and strategic readers (quadrant A), then the students can be expected to develop a relatively deep understanding (Graesser, Singer, & Trabasso, 1994; Guthrie & Alao, 1997). If, on the other hand, educators choose relatively easy texts and their students are less-skilled, or less motivated to engage in strategic processes (quadrant B), then students can be expected to develop a more superficial, or textbase level of understanding (McKoon & Ratcliff, 1992). Likewise, strategic or skilled students can be expected to construct a relatively coherent textbase when they face a challenging, knowledge-demanding text (quadrant C; McNamara, 2004; O'Reilly & McNamara, 2007a, 2007b). By contrast, given a text with relatively familiar material containing numerous conceptual gaps (i.e., the reader is high in knowledge), students can be expected to develop a coherent situation model because students with sufficient knowledge will be able to generate the gap-filling inferences (McNamara et al., 1996). The worst levels of comprehension can be expected for less-skilled or unmotivated readers who encounter overly challenging texts. Students without sufficient prior knowledge, and who also lack sufficient reading comprehension skills, can be expected to understand little from text (O'Reilly & McNamara, 2007a).

Interpret student reading performance by considering the test used

Our review on the assessment of reading comprehension has highlighted that students' likelihood of success in reading and comprehension depends on the material that is read and the task that is completed during or after reading this material (Fletcher, 2006). Research indicating that common tests of comprehension do not tap into the same array of language and cognitive processes suggests that performance on reading comprehension tests may be influenced to different degrees by particular skills and different processes during comprehension.

These findings imply that different measures of reading comprehension can yield useful information for the educator *only* if we know the exact set of skills on which students' performance on the specific measure depends (Kendeou & Papadopoulos, 2008, in press). In the absence of such information, these measures provide only a basic indication of how well a student understands text and offer very little information about why some students may struggle while others succeed.

A departure point is an awareness that various assessments will provide more or less information about a student's abilities, and different information depending on the particular assessment. Nonetheless, one constraint faced by educators is that common and available measures of students' comprehension abilities generally provide a single score, under somewhat artificial, unmotivating circumstances. Educators need access to assessments that are indicative of the students' ability to draw inferences and build coherent mental representations of text. They also need access to comprehension assessment techniques that are likely to reflect a student's deep understanding of material.

For example, oral retelling after reading a text can be reflective of a student's deeper level understanding (Kendeou et al., 2009). The underlying assumption of retelling is that when readers retell a story, they draw on their mental representation of the text read. This mental representation is the product of inferencing during which readers interconnect the events in the text with their prior knowledge, which primarily depends on the reader's situation model level of understanding. There are numerous other approaches to comprehension assessment that will tap into deeper levels of comprehension, such as summarization, self-explanation, challenging comprehension questions, problem solving questions, and essay writing.

Conclusions

Our understanding of comprehension has matured based on decades of research on text and discourse processing. An ongoing challenge is the translation of those findings into practice. Our list summarizes what we consider to be a few of the most important findings and their corresponding translations to educational practice. Of course we know much more about comprehension than summarized in this brief review (McNamara & Magliano, 2009; Perfetti, 1985; Pressley, 1998, 2000; RAND Reading Study Group, 2002).

In addition, research on reading comprehension can inform educational practice, which in turn, should feed back to basic research in reading comprehension. For example, *effective reading comprehension instruction in mixed-ability classrooms* has a large impact on standardized measures of reading comprehension. Reading comprehension research needs to be informed directly as to the factors that lead to a broad impact on students' reading comprehension. This will necessitate a comprehensive examination of classrooms as complex systems, taking into account the teacher, the students, the approaches, the materials, and their respective interactions. A second example is *the relation between reading comprehension and writing*. In educational settings, the two are closely linked and taught building upon one another. Research in these two areas, however, has been relatively unconnected. Both researchers and educators would benefit from increased cross-talk among these areas and a consideration of how each influences and is being influenced by the other.

Perhaps one of the largest gaps in our understanding of comprehension processes regards how students process and understand information in multimedia environments (Mayer, 2001; McNamara & Magliano, 2009; van den Broek, Kendeou, & White, 2009). This dearth in research ranges from the students' processing of texts and pictures, to understanding material on the web, to the integration of information from various sources and mediums (e.g., text, video, discourse, pictures). These are areas we expect to garner increased attention by researchers in the near future.

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