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The prediction of reading comprehension by cognitive and motivational factors: Does text accessibility during comprehension testing make a difference?

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ABSTRACT

This study examined the unique contributions of various predictors to reading comprehension measured either *without* or *with* access to the text during testing. Reasoning ability, prior knowledge, and decoding skills were assumed to have stronger contributions to comprehension without text access than with text access, whereas current motivation should be more strongly associated with comprehension measured with access to the text. Metacognitive strategy knowledge and test anxiety were expected to be equally associated with comprehension in the two test conditions. Participants were 424 eighth- and ninth-grade students. They were presented with several instruments measuring cognitive and motivational predictors and read a text on a mathematical topic; then half of them took a test on comprehension either without or with text access. Based on multiple-group structural equation modeling, results indicated that reasoning ability, decoding ability, and metacognitive strategy knowledge significantly predicted comprehension only in the without-text condition, whereas achievement motivation and test anxiety significantly predicted comprehension only in the with-text condition. The unique contributions of intrinsic motivation to comprehension were significant, but did unexpectedly not differ between the without-text and the with-text condition.

1. Introduction

Reading comprehension is a complex task that depends on both cognitive and motivational processes (Guthrie, Wigfield, Metsala, & Cox, 1999). Previous research evidences that a range of different factors including reasoning ability, prior knowledge, strategy knowledge, decoding skills, and intrinsic as well as extrinsic motivation contribute to the prediction of reading comprehension (Artelt, Schiefele, & Schneider, 2001; Cox & Guthrie, 2001). More recently, it was demonstrated that the unique contributions of individual predictors may depend on how comprehension is measured (Andreassen & Bråten, 2010; Cutting & Scarborough, 2006; Ozuru, Best, Bell, Witherspoon, & McNamara, 2007). In the present study, we focused on two ways of assessing reading comprehension, namely through comprehension tests *without* access to the text and *with* access to the text during question answering. Both measures have been widely used by researchers to assess comprehension of extended text passages (cf. Artelt et al., 2001; Ozuru et al., 2007). However, partly different comprehension processes and products are likely to be associated with these forms of testing (Magliano, Millis, Ozuru, & McNamara, 2007). Therefore, text accessibility is of major relevance in educational settings. In school, for example, students are often required to either memorize information included in a text or to answer comprehension questions with the text at hand. Thereby, it is important to distinguish between the effect of text accessibility during comprehension assessment (test format) and the effect of receiving an instruction that leads the reader to anticipate having access to the text or not (reading instruction). In educational settings, it seems most probable that test format and reading instruction are combined. Even if explicit reading instructions are not given, students learn through experience which forms of testing they have to expect (d'Ydewalle, 1984; McDaniel, Blischak, & Challis, 1994). As a consequence, recent studies comparing students' comprehension performance without vs. with text access combined corresponding test formats and reading instructions (Andreassen & Bråten, 2010; Ozuru et al., 2007).

The main goal of the present study was to examine whether the size of the contributions of cognitive and motivational predictors to reading comprehension depends on text accessibility. In the following, we first define reading comprehension. Then, we describe relevant cognitive and motivational reader characteristics and discuss their role in comprehension measured without and with text access.

1.1. Reading comprehension

Reading comprehension involves the extraction of meaning from text and results from an interactive process between the text and the reader (Butcher & Kintsch, 2003; Kintsch, 1998). Accordingly, comprehension performance depends on text features (e.g., coherence) and reader characteristics (e.g., prior knowledge). The resulting mental representation includes two components (in addition to a short-lived representation of

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the actual wording of the text): the textbase and the situation model (Kintsch, 1998; Zwaan & Singer, 2003). The textbase captures the ideas mentioned explicitly in a text, whereas the situational representation entails a mental model of the situation described in the text. This mental model strongly depends on the integration of text information with prior knowledge.

At both the textbase and the situational level of representation, inferences are highly important (Graesser, Singer, & Trabasso, 1994; Zwaan & Singer, 2003). Bridging inferences link the current clause or sentence to the preceding text and thus help to establish coherence (e.g., referring a noun phrase to the prior text), whereas elaborative inferences are strongly implied by the discourse context but are not needed for preserving coherence (e.g., associating text information with facts retrieved from long-term memory). Particularly elaborative inferences involve reasoning processes based on prior knowledge and play a crucial role in constructing a situation model (Kintsch, 1998; Tapiero, 2007).

Furthermore, memory processes are strongly implicated in the ability to comprehend text (Butcher & Kintsch, 2003; Kintsch, 1998). Information from the text and the reader's long-term memory need to be processed and integrated. The demands of creating a coherent text representation, for example, strongly require working-memory resources. Current idea units must be maintained in memory while at the same time new text is decoded and processed.

In the present study, we also referred to the framework of reading literacy that was used in the PISA study (OECD, 2001; see also Artelt et al., 2001). At the core of this conception, three dimensions of reading literacy were distinguished: *retrieving* specific information from the text, *interpreting* the text information, and *reflecting* on the content or form of the text. Whereas the dimension of retrieving corresponds to the textbase, the interpreting and reflecting dimensions address inferential processes and the application of text information to new situations and, thus, are closely related to the situation model.

1.2. Cognitive and motivational predictors of reading comprehension

Previous research has provided substantial evidence that the ability to comprehend text is associated with a number of cognitive and motivational characteristics of the reader (Dutke, 2000; Guthrie et al., 1999; Kintsch, 1998; Schaffner, 2009; Schiefele, 1999; van der Stel & Veenman, 2008). In the present study, we focused on the following *cognitive* determinants of reading comprehension: reasoning ability, prior knowledge, metacognitive strategy knowledge, and decoding skills. The contributions of these factors to reading comprehension were compared with the contributions of *current motivation* and *test anxiety*.

1.2.1. Cognitive predictors

Reasoning ability and prior knowledge are among the most important predictors of reading comprehension (Alexander & Kulikowich, 1991; Francis et al., 2006; Kendeou & van den Broek, 2007; Kintsch, 1998; Schneider, Körkel, & Weinert, 1990). *Reasoning ability* represents a central component of fluid intelligence (Gustafsson, 1984) and is mostly understood as the ability for *inductive* (as opposed to deductive) reasoning. Typical tasks measuring inductive reasoning involve, for example, classifications, analogies, incomplete series, and matrices (Klauer & Phye, 2008). Inductive reasoning is aimed at detecting generalizations, rules, or regularities. It thus refers to the formation of conclusions or inferences from specific facts or observations (Klauer & Phye, 2008; Sternberg & Williams, 2002) and is supposed to be an important condition of readers' "inference-making ability" (Cain, Oakhill, Barnes, & Bryant, 2001).

In text comprehension research, *prior knowledge* usually refers to that part of a person's world knowledge that is related to a particular text. Most often, researchers have assessed students' text-related *domain knowledge* (e.g., physics) that is described as "a realm of knowledge that broadly encompasses a field of study or thought" (Alexander, Schallert, & Hare, 1991, p. 332). Because comprehension can be defined as the integration of new information with existing knowledge (e.g., Kintsch, 1998), the amount of prior knowledge represents a major prerequisite of discourse processes.

Both reasoning ability and prior knowledge have been identified by prior research to strongly impact crucial comprehension processes, such as the identification of main ideas and the generation of inferences (Cain & Oakhill, 1999; Cain et al., 2001; Graesser et al., 1994; Kendeou & van den Broek, 2007; Kintsch, 1998; Tarchi, 2010). Accordingly, reasoning ability and prior knowledge are of particular importance for constructing a situation model (Kintsch, 1998; Tardieu, Ehrlich, & Gyselinck, 1992).

Although reasoning ability and prior knowledge have been confirmed as highly important factors in reading comprehension, substantial contributions are also to be expected from decoding skills and metacognitive strategy knowledge. *Decoding skills* refer to low-level processes and involve the ability to recognize letters and words (Kuhn & Stahl, 2003). As such, they constitute an important aspect of reading fluency. Numerous studies revealed significant effects of word decoding skills or reading fluency on reading comprehension of elementary and secondary school students (Andreassen & Bråten, 2010; Artelt et al., 2001; Best, Floyd, & McNamara, 2008; Cutting & Scarborough, 2006).

Metacognitive strategy knowledge refers to effective comprehension strategies and the conditions of their use (Baker, 1989; Kuhn & Pearsall, 1998) and enables readers to choose those particular strategies during reading that are most helpful in forming a coherent and well-elaborated text representation (O'Reilly & McNamara, 2007). For example, when reading for a specific study goal, such as learning for a test, the reader needs to monitor his or her comprehension processes in order to become aware of potential comprehension gaps. Moreover, to overcome a particular comprehension gap, an adequate reading strategy has to be chosen (e.g., rereading a text passage).

1.2.2. Motivational predictors

In the present study, we focused on the contribution of various forms of *current* motivation to reading comprehension. In contrast to *habitual* or *trait-like* motivation (e.g., motives), *current* motivation refers to states of being motivated in a specific situation (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). As such, current motivation should be a stronger predictor of performance in a particular situation than habitual motivation.

In order to identify relevant constructs of current motivation, we referred to theories of motivation being highly important in educational contexts: theories of intrinsic motivation (e.g., Ryan & Deci, 2000, 2002) and achievement goals (Grant & Dweck, 2003; Pintrich, 2000; Pintrich, Conley, & Kempler, 2003). Also in line with past research on the effects of current motivation on text learning (see Schaffner & Schiefele, 2007b, for an overview), the following constructs of current motivation were included in the present study: *intrinsic motivation*, *noncompetitive achievement motivation*, and *competitive achievement motivation*.

Previous research demonstrates strong evidence for a positive relation between current *intrinsic motivation* (e.g., wanting to learn about an interesting topic) and reading comprehension (cf. Schaffner & Schiefele, 2007b). The positive relation between intrinsic motivation and comprehension has been explained by the facilitation of deep-level strategies and increased attention while reading (Benware & Deci, 1984; Pintrich & De Groot, 1990).

In the literature on the relation between achievement goals and learning (e.g., Pintrich, 2000) a distinction is made between *approach-oriented* achievement goals (i.e., striving for good grades) and *avoidance-oriented* achievement goals (i.e., striving for avoiding failure). According to Grant and Dweck (2003), *approach-oriented* achievement goals have been either defined as a competitive