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The effects of updating ability and knowledge of reading strategies on reading comprehension

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ABSTRACT

Updating ability and reading strategies are considered as important factors in the buildup of a mental model of a text. However, only few studies examined the relation of updating and knowledge of reading strategies with reading comprehension. The aim of the current study was to investigate the specific effects of updating ability and knowledge of reading strategies on reading comprehension, controlling for reading speed, vocabulary, and short-term memory. One-hundred-and-ninety-five Dutch fourth graders were administered two standard Dutch reading comprehension tests, and measures of updating ability, knowledge of reading strategies, reading speed, vocabulary, and verbal short term memory. The results showed that updating ability did not contribute to reading comprehension, when other predictors were controlled, whereas knowledge of reading strategies had an independent effect on reading comprehension. The relations of updating ability and knowledge of reading strategies, as well as those of other predictors, with reading comprehension were similar across the two reading comprehension tests.

1. Introduction

Text comprehension is a complex cognitive activity (Rapp & van den Broek, 2005). Abundant evidence shows that the comprehension of a text is dependent on word decoding and general language skills, such as vocabulary knowledge (e.g., Hoover & Gough, 1990, Verhoeven & Perfetti, 2008). Beyond these foundational skills, more general cognitive and metacognitive processes are involved. In the current study we focused on the relationships of updating ability and knowledge of reading strategies with individual differences in reading comprehension.

Understanding a text requires the buildup of various representations (Kintsch, 2012). The surface representation includes the form of words and their syntactic relations. The textbase consists of the meaning of words and connections between sentences. The situation model is a coherent representation of the situation described in the text. Several models of reading comprehension suggest that the process of text comprehension, especially the construction of a situation model, is related to updating (Gernsbacher & Foertsch, 1999; Kintsch, 2012; van den Broek et al., 1996; Zwaan, Langston, & Graesser, 1995). For example, in the construction-integration model updating can be considered as the integration of knowledge from the textbase with readers' prior knowledge (Kintsch, 2012). The subsequent activation of concepts in the landscape model and the refinement of their interconnections might also be seen as un updating process (van den Broek et al., 1996). The event indexing model assumes that the comprehension of an event in the text is associated with the monitoring and updating of the situation model on a number of indices (i.e., temporality, spatiality, protagonist, causality, and intentionality) (Zwaan, et al., 1995). For example, if an event indicates a time shift in the story, then the temporal index of the situation model will be updated. The structure building model describes that during mental model building, the building blocks of the structure (i.e., memory nodes) are activated or suppressed, depending on whether the information they represent is necessary for further structure building (Gernsbacher & Foertsch, 1999). This process of enhancing or suppressing activation of memory nodes might be seen as updating.

In addition to updating, inferences are generally assumed to be important for the construction of a situation model (Cain & Oakhill, 1999). Such a model does not only consist of information stated explicitly in the text, but also depends on inferences that go beyond the text, being the result of an interplay between information in the text and readers background knowledge (Zwaan & Radvansky, 1998). Which inferences are generated is determined by the readers' goal and by coherence and explanation strategies (Graesser, 2007). Individual differences in reading comprehension might therefore depend on the knowledge and use of such strategies. Indeed, a major method to foster inference making, and thereby reading comprehension, is the training of reading strategies (e.g., Brand-Gruwel, Aarnoutse, & van den Bos, 1998; Spörer, Brunstein, & Kieschke, 2009).

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Theoretically, updating ability and the availability or knowledge of reading strategies are considered important for text comprehension. However, there are few studies in which their relationship with reading comprehension has been examined in a sample of typically developing children (e.g., Cain, 1999).

1.1.. Updating

Updating during reading comprehension is the process of incorporating new information into the existing mental model (Zwaan & Radvansky, 1998), or more generally, modifying the current representation of information in memory to hold new information (Morris & Jones, 1990). Updating is assumed to be one of the components of the central executive system of working memory (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; van der Sluis, de Jong, & van der Leij, 2007). Numerous studies have shown that working memory is involved in reading comprehension (Cain, Oakhill, & Bryant, 2004; Daneman & Merikle, 1996). However, most of these studies involved broader measures of working memory, such as complex span tasks, and did not concern updating proper (Carretti, Borella, Cornoldi, & de Beni, 2009).

Palladino, Cornoldi, de Beni, and Pazzaglia (2001) were among the few who considered updating in relation to reading comprehension. In their first experiment, poor and good adult comprehenders were asked to recall the last four words from auditory presented lists of unknown length. Poor comprehenders performed more poorly on this task than good comprehenders. However, because most participants reported that they did not update at all, but just recalled the last words they had heard, task performance seemed to depend mostly on recency effects (Elosúa & Ruiz, 2008; Palladino & Jarrold, 2008). Therefore, in a second experiment, Palladino et al. (2001) administered a task with a semantic criterion, thereby rendering some of the stimuli to be irrelevant. In this task, the last three or five smallest items of the list had to be recalled. This criterion necessitates updating, because the last items were not necessarily the smallest ones. Also with this modified updating task, Palladino et al. found that the poor comprehenders performed worse than the good comprehenders.

Carretti, Cornoldi, de Beni, and Romanò (2005) argued that the semantic criterion used by Palladino et al. (item size) was ambiguous, since the size of objects is not fixed. For example, a suitcase might be considered both smaller and bigger than a television. Therefore, Carretti et al. (2005) used a different updating task with an objective criterion: the place of an item in a row. However, an updating task with a semantic criterion seems to be a better reflection of the updating process during reading comprehension than an updating task with item place as criterion.

The first aim of the current study was to investigate the relationship between updating ability and reading comprehension. For the updating task, we used an unambiguous semantic criterion, the selection of animals or body parts from series of words. Filler items were added to the series to avoid recency effects (Elosúa & Ruiz, 2008; Palladino & Jarrold, 2008). Unlike previous studies that focused on poor and good comprehenders, we investigated the relationship between updating and reading comprehension in an unselected sample of typically developing children.

1.2. Reading strategies

Reading strategies are generally believed to facilitate text comprehension (Graesser, 2007). Various types of measures of reading strategies can be distinguished. One type requires the use of a particular reading strategy during passage reading which is followed by comprehension questions (e.g., Spörer et al., 2009). A disadvantage of this measure is that it remains unclear whether strategies are used correctly if not explicitly instructed. In a metacognitive awareness inventory of reading strategies, another type of measure, participants have to report how often they use particular reading strategies during reading (Cantrell, Almasi, Carter, Rintamaa, & Madden, 2010; Mokhtari & Reichard, 2002). Unfortunately, strategies are often used automatically and unconsciously. Therefore, it seems difficult to report about how often these strategies are used (Cromley & Azevedo, 2006). Indeed, Cromley and Azevedo did not find a relationship of such a questionnaire with reading comprehension. In this study we focused on knowledge of reading strategies (Gruwel & Aarnoutse, 1995). We made a distinction between knowledge of how to clarify parts of the text that are incomprehensible for the reader and how to control and evaluate the reading process (see also, Cross & Paris, 1988).

1.3. Present study

This study focused on two core factors related to the construction of a situation model, updating ability and knowledge of reading strategies. To examine their specific effects on reading comprehension, we controlled for foundational skills as word reading speed and vocabulary (Verhoeven & Perfetti, 2008). Several studies have shown that the relationship of various cognitive abilities with reading comprehension can differ across tests (Andreassen & Bråten, 2010; Keenan, Betjemann, & Olson, 2008; Kendeou, Papadopoulos, & Spanoudis, 2012). Therefore, to examine the generalizability of the results, we included two standard reading comprehension tests. We expected both updating ability and knowledge of reading strategies to have a specific positive effect on both reading comprehension tests.

2. Methods

2.1. Participants

Participants were 195 Dutch fourth graders from seven regular elementary schools in the Netherlands of which 82% was native speaker. The sample comprised 102 boys and 93 girls with a mean age of 9;10 years ($SD = 5.89$ months).

2.2. Measures

Measures were selected to investigate updating ability, reading strategies, and reading comprehension. Measures for reading speed, vocabulary knowledge, and verbal short term memory were used as control variables.

2.2.1. Updating ability

Updating ability was measured with a word updating task. Children were required to recall the last two or three target items (animals or body parts) from series of unknown length. All series contained target items and filler items, nouns that are not an animal or a body part. Both the target items and fillers were selected from a list of words commonly known by six-year-old children (Schaerlaekens, Kohnstamm, & Lejaegere, 1999). All target items, 20 animals and 20 body parts, and 40 filler items were monosyllabic concrete nouns. Series were created by randomly selecting four to seven target items for each series. Then, the same number of fillers as target items was randomly selected and added to each series. Zero to two fillers were placed between the target items, so that maximally two target items were consecutive. Series always started with a target item, and ended with one or two fillers. Series comprised two or three target items to be recalled and two to four target items to be updated, which resulted in list lengths between eight and 14. The task was programmed in E-Prime version 2.0 (Schneider, Eschman, & Zuccolotto, 2010). Series were presented auditorily in a fixed order with a speed of one word per two seconds. To fixate the attention of children at the start of each series, the children were told that the next series would start. At the end of each series, children had to recall the target words verbally. The answer was registered on a scoring sheet. There were 16 series in total, part one consisted of eight series with animals as target items and part two comprised eight series with