

Preparing for reading comprehension: Fostering text comprehension skills in preschool and early elementary school children

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Abstract

To understand what they read or hear, children and adults must create a coherent mental representation of presented information. Recent research suggests that the ability to do so starts to develop early –well before reading age- and that early individual differences are predictive of later reading-comprehension performance. In this paper, we review this research and discuss potential applications to early intervention. We then present two exploratory studies in which we examine whether it is feasible to design interventions with early readers (3rd grade) and even toddlers (2-3 years old). The interventions employed causal questioning techniques as children listen to orally presented, age-appropriate narratives. Afterwards, comprehension was tested through question answering and recall tasks. Results indicate that such interventions are indeed feasible. Moreover, they suggest that for both toddlers and early readers questions *during* comprehension are more effective than questions *after* comprehension. Finally, for both groups higher working memory capacity was related to better comprehension.

Keywords: Reading comprehension, early intervention

Introduction

Children who experience difficulties reading and understanding information that is presented to them tend to suffer from problems in school and in their communities (e.g., NCES, 2010; NICHD, 2000). Not only are school experiences difficult for these children, but many aspects of their lives are severely hindered as they grow older. Thus, it is essential that

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we understand the processes that lead to successful reading comprehension and the ways in which these processes can be developed in young children. Such understanding can have far-reaching implications for educational practice, particularly with respect to assessment, diagnosis, and early intervention of reading difficulties.

In this paper, we first discuss the cognitive processes underlying reading comprehension, the development of reading comprehension, and difficulties experienced by struggling readers. We then present the results of two targeted, small-scale intervention studies aiming to support the development of reading comprehension skills in young children. Finally, we discuss the theoretical and practical implications derived from the results of this research.

Cognitive processes in reading comprehension

A common theme that has emerged from research examining the cognitive processes of reading comprehension is that, to comprehend a text, it is essential that a reader be able to decode language units and to construct a coherent mental representation of the text (e.g., Gernsbacher, 1990; Graesser, Singer, & Trabasso, 1994; Kintsch & van Dijk, 1978; Trabasso & van den Broek, 1985; van den Broek, 1994; Wagner, Piasta, & Torgesen, 2006; Whitehurst & Lonigan, 1998; Zwaan & Rapp, 2006). This representation can be accessed by the reader for different purposes after reading is completed: to recall information from the text, to answer questions, to apply the knowledge obtained from the text, and so on.

Investigations of the construction of coherent representations focus on the cognitive processes involved during reading comprehension itself, as they occur moment-by-moment when the reader proceeds through a text (*online*), as well as the resulting representations (*offline*) once reading has been completed. The online construction of a coherent mental representation of the text involves a complex set of processes such as connecting and integrating the text information that the reader currently is reading with information that occurred earlier in the text as well as with information from background knowledge. Some of these processes are quick, automatic, and relatively effortless, whereas others are slow, strategic, and relatively effortful. These processes are constrained by the limitations of working memory and by the *standards of coherence* that a reader attempts to maintain in a particular reading situation (e.g., van den Broek, in press; van den Broek, Risden, & Husebye-Hartmann, 1995; van de Velde, 1989).

The offline memory representation of the text and relevant background knowledge emerges from the processes and strategies readers employ during reading. Thus the offline representation and the online processes are causally related: The processes that unfold during moment-by-moment reading comprehension provide the basis for the construction of the offline text representation. If the online processes fail, so does the final text representation.

Development of reading comprehension

Research on reading development in preschool and early elementary-school children has provided important insights about the nature of the development of comprehension skills at this early age (for reviews of research on developmental changes in comprehension skills, see, for example, Applebee, 1978; van den Broek, 1997; van den Broek, Bauer, & Bourg, 1997; van den Broek & Kremer, 1999).

Specifically, investigations of children's memory for narratives show that children at an early age can and do engage in inferential processes, identifying meaningful relations and establishing coherence (Trabasso, Secco, & van den Broek, 1984). For example, when 4- and 6-year old children watch television programs, they tend to recall events with many causal connections better than events with fewer causal connections (van den Broek, Lorch, &

Thurlow, 1996). However, there are also systematic age differences. For instance, older children are more sensitive to the causal structure of a story than are younger children. In addition, older children are able to identify causal relations that span across multiple episodes and events in a story, whereas younger children tend to focus on recalling causal relations that occur within a particular episode of a story. Identifying causal relations across multiple episodes of a story leads to a broader and deeper understanding, for example of the story's overall theme (Williams, 1993). Furthermore, whereas older children are able to notice relations involving more abstract components such as underlying intentions and goals of characters, younger children tend to emphasize relations between concrete events in a story (van den Broek, 1997; Williams, 1993). These developmental trends reflect at least two major factors of change as children grow older: the different experiences that children have had and the increasing efficiency of their working memory.

Research on the development of language comprehension skills from preschool to early elementary school and their relation to beginning reading comprehension has shown that language comprehension and decoding skills are strongly interrelated in preschool but that their relation is weaker in kindergarten and first grade (Kendeou, van den Broek, White & Lynch, 2009). Importantly, language comprehension skills independently predict a child's reading comprehension over and above decoding skills (see also Storch & Whitehurst, 2002). The results of several other studies also highlight the importance of language comprehension skills in early reading development (Bishop & Adams, 1990; Cain & Oakhill, 2007; Cain, Oakhill, & Bryant, 2004; Catts, Fey, Zhang, & Tomblin, 1999; Paris & Paris, 2003). These findings have important theoretical and practical implications with respect to assessment in the early years of schooling, as well as interventions. We turn to this issue next.

Interventions to enhance reading comprehension

There is an impressive body of literature on reading comprehension interventions (Gersten, Fuchs, Williams, & Baker, 2001; Swanson & Hoskyn, 2001). Recent reviews of this literature have highlighted that reading comprehension improves when readers are explicitly taught various strategies such as activating prior knowledge, self-monitoring, summarizing, identifying text structures, and questioning (Faggella-Luby & Deshler, 2008). In the context of the present set of studies, we focus on questioning strategies. Questioning is an effective way to help readers construct a coherent representation of a text because it directs readers' attention to making essential connections for coherence. Existing research provides important guidance about the type of questions to ask, and about the appropriate timing of those questions.

With respect to the type of questions, it is important to consider what types of information are most useful for establishing coherence. As mentioned before, causal relations have been found to be particularly important for establishing coherence (e.g., Goldman & Varnhagen, 1986; Trabasso & van den Broek, 1985; Trabasso, van den Broek & Liu, 1988). The causal relations that readers must infer are many and complex and may extend over long distances in the text. Thus, causal questions can potentially direct the reader to attend to specific causal information in the text. Indeed, when asked causal questions, readers recall more causally connected events in narrative text than they recalled when asked general questions (McMaster, van den Broek, Espin, White, Rapp, Kendeou, Bohn-Gettler & Carlson, 2011).

With respect to the timing of questions, different questioning techniques have been used during reading to assist readers in identifying the relations that are necessary for constructing a coherent representation of the text (e.g., Hansen & Pearson, 1983; McKeown, Beck, & Blake, 2009; Trabasso & van den Broek, 1985; van den Broek et al, 2001; Yuill &

Oakhill, 1988). Consistent with the notion, mentioned above, that the cognitive processes during reading are the major determinants of success or failure in reading comprehension, it appears that for relatively proficient readers, questioning techniques *during* reading are more effective than questions *after* reading has been completed. However, interrupting the reading process with questions may be less helpful for younger children because it will direct attention and resources away from maintaining coherence (Goldman, 2004). Indeed, van den Broek et al. (2001), who investigated the timing of questioning in 4th, 7th, 10th grade and college students, showed that questioning during reading is beneficial for 7th grade and college students, but for 4th grade students, the youngest group in the study, questioning after reading was most beneficial.

Based on the findings on early development of comprehension and inference-making skills, one might surmise that it is possible to develop skills relevant to text-comprehension skills even before children can read. In the following pilot studies we explore whether it is possible to devise inference-fostering interventions modeled after the questioning methods used with older children at a very young age –for 8- to 9-year old 3rd grade children and for 2- to 3-year old toddlers. In addition, we explore whether factors such as timing of the questioning –during vs. after listening to the stories- matters and whether factors such as the child's working memory capacity and gender also influence comprehension at these ages.

Study 1- Intervention for Pre-Readers

Participants

Participants were 40 children aged 2-3 years in a day nursery in the Netherlands. The number of girls and boys was equal in the two question-timing conditions. The average age was 2.74 years ($SD = .46$).

Materials

All participants completed tests that assessed their working memory, and their comprehension and memory of three narratives. The comprehension and memory of the narratives was measured with two different traditional procedures for assessing story comprehension, namely comprehension questions and recall tasks (Pearson & Hamm, 2005). The narratives used were stories from two story books with pictures for young children 'Dikkie Dik' (Bruna, 2008) and 'Nijntje in the zoo' ('Nijntje in de dierentuin', Boeke, 2008). All three narratives were stories about animals and were age appropriate in linguistic complexity. The stories were 83, 98, and 287 words, 12, 16, 49 sentences long, respectively. The questions used to assess comprehension consisted of causal questions aimed at connecting events within each narrative. Narratives one and two had five each questions and narrative three had 10 questions, placed at natural points in the text (e.g., end of paragraph, end of page). Depending on the condition, questions were asked either during or after listening to the narrative. If the child did not respond, one neutral prompt was given. The questions were identical across conditions. Working memory capacity (WMC) was measured with the imitation sorting task (IST; Alp, 1994). The imitation sorting task measures the maximum amount of information children can simultaneously store and process.

Procedure

Participants were randomly assigned to one of two experimental conditions for each story. All children received all stories. Girls and boys were equally divided over the conditions. In each session, an experimenter read the narratives to the child and asked the causal questions either during or after the narrative (depending on condition). After each narrative was read and the questions asked, participants were asked to recall the whole story while looking at

pictures from the narrative. Participants were tested individually and each session lasted approximately 30 minutes.

Results

Two separate ANCOVA's were carried out with timing of questioning as the independent variable (during vs. after), working memory and gender as covariates, and children's recall and questions scores as the dependent variables, respectively. For the two dependent variables, recall and questions, we created difference scores by subtracting from a child's total score the mean score to account for potential differences in variance among the three narratives. Given the exploratory nature of the study and the small N, results at $p < .10$ are discussed.

The comprehension scores for the on-line questioning condition were higher than those for the off-line questioning condition, for both question-answering and recall. This difference was significant at the $p < .10$ level for recall ($F(1, 39) = 3.27, p = .07, \eta^2 = .08$). Among the covariates, children's WMC scores were positively related to their scores on the question-answering task $F(1, 39) = 28.75, p < .001, \eta^2 = .34$, as well as on the recall task $F(1, 39) = 10.75, p < .001, \eta^2 = .22$.

Study 2- Intervention for Young Readers

Participants

Participants were 42 3rd grade children aged 8-9 years old in an elementary school in the Netherlands. The number of girls and boys was equal in the two question-timing conditions. The average age was 8.61 ($SD = .47$).

Materials

All participants completed tests that assessed their working memory, and their comprehension and memory of two narratives. As in Study 1, the comprehension and memory of the narratives was measured using comprehension questions and recall tasks (Pearson & Hamm, 2005). The narratives were stories from the children's book 'Hare and Rabbit' ('Haas en Konijn', Delft, 2000). Both narratives were age appropriate. The stories were 834 and 796 words, 106 and 113 sentences long, respectively. The questions consisted of causal questions aimed at connecting events within each narrative. Each narrative had 10 questions, placed at natural points in the text (e.g., end of paragraph, end of page). The questions were identical across conditions. Working memory capacity (WMC) was measured using the using a Dutch translation of the Sentence Span Measure (Swanson, 1995).

Procedure

Participants were randomly assigned to one of two experimental conditions. Stories and conditions were counterbalanced so that across the children all stories occurred in each condition. Girls and boys were equally divided over the conditions. In each session, an experimenter read the narratives to the child and asked the causal questions either during or after the narrative (depending on condition). If the child did not respond, one neutral prompt was given. After each narrative was read and the questions asked, participants were asked to recall the whole story while looking at pictures from the narrative. Participants were tested individually and each session lasted approximately 30 minutes.

Results

Two separate ANCOVA's were carried out with timing of questioning as the independent variable (during vs. after), working memory and gender as covariates, and children's recall and questions scores as the dependent variables, respectively. For the two dependent

variables, recall and questions, we again created difference scores by subtracting from a child's total score the mean score to account for potential differences in variance among the three narratives.

Given the exploratory nature of the study and the small N, results at $p < .10$ are discussed. The comprehension scores for the on-line questioning condition were higher than those for the off-line questioning condition, for both question-answering and recall. This difference was significant at the $p < .10$ level for questioning-answering ($F(1, 20) = 3.46, p = .07, \eta^2 = .28$). Among the covariates, children's WMC scores were positively related to their scores on the question-answering task $F(1, 39) = 14.84, p < .001, \eta^2 = .52$, as well as on the recall task, $F(1, 39) = 22.25, p < .001, \eta^2 = .60$.

General Discussion

To understand what they read, children and adults must create a coherent mental representation of the presented information. To do so, they need to identify relations between various parts of the information, often through inferential processes. As detailed in the literature review in this paper, results from recent cross-sectional and longitudinal studies indicate that the ability to connect pieces of information and to create coherence starts to develop early –well before reading age. Moreover, they show that individual differences in comprehension skills at an early age (as young as 4 years) are predictive of later reading-comprehension performance (in the middle and upper elementary school grades), independently from decoding and other basic skills.

These findings raise the possibility that early interventions could be developed and used to put very young children on the right track towards becoming good readers. This possibility is important to explore as report after report notes that many elementary school children do not develop adequate reading comprehension skills (National Center for Education Statistics, 2010; Coulombe, Tremblay, Marchand, 2004; Verhoeven, Biemond, Gijssels, & Netten, 2007).

The findings from two exploratory studies demonstrate that it is possible to design and implement interventions aimed at fostering text comprehension skills in early readers (3rd grade) and even toddlers (2-3 years). These interventions were modeled after questioning techniques that have been employed successfully in a reading context with children in later elementary school and high school (e.g., McMaster et al., 2011). In a listening context, causal questions are used to encourage children to identify semantic relations between various parts of age-appropriate stories that are being read to them (e.g., Kendeou, Lynch, van den Broek, Espin, White & Kremer, 2005; van den Broek, Kendeou, & White, 2009).

Besides showing the feasibility of interventions at early ages, the results suggest that for both age groups questions *during* comprehension are more effective. This is consistent with the view (Rapp, van den Broek, McMaster, Kendeou & Espin, 2007) that the *process* of comprehension is where the foundation for success and failure in comprehension is determined. It is at odds with earlier findings in reading contexts (e.g., van den Broek, Tzeng, Ridsen, Trabasso & Basche, 2001) that 4th grade students sometimes perform better following a questioning *after* reading than following an intervention *during* reading. In these earlier studies it was hypothesized that the decoding of the text itself required a considerable portion of a child's attentional and processing capacities and that the added burden of having to read and answer questions during reading was detrimental to comprehension and memory. The current findings are consistent with this explanation: when the demands on decoding were reduced by using a listening task, the benefit of eliciting online processes re-emerged. From a practical point-of-view this suggests that

comprehension-building interventions may be most beneficial when presented in a format that does not require extensive other skills such as decoding.

In studies with adult readers, an important factor affecting the ability to make inferences and comprehend a text consists of the reader's working memory capacity (Kaakinen, et al., 2003; Linderholm & van den Broek, 2002). Differences in working memory capacity also have been implicated as an important factor in determining comprehension performance by elementary school readers (Cain, Oakhill, & Bryant, 2004). The results in the present studies extend the role of working memory as a powerful factor in comprehension to an even younger age. For both 3rd grade students and toddlers differences in working memory capacity were strongly related to differences in comprehension performance, as measured by recall and questioning tasks (effect sizes of .22 and .34 for toddlers and of .55 and .60 for the 3rd grade children).

In conclusion, the findings on the effects of questioning on comprehension in 3rd grade children and toddlers show that the approach of developing early interventions using non-reading contexts aiming to enhance children's inferential and comprehension skills may have considerable promise. It would be worthwhile to engage in full-scale investigations of the effectiveness of such interventions and of properties that determine their impact, such as timing, intensity, duration, types of questions, and so on. Longitudinal studies are needed to determine long-term effects and whether they indeed lead to improved reading comprehension in later years. In the past, we have argued that it is essential to select or design interventions that address the underlying causes of the difficulties struggling readers face (Kendeou, van den Broek, White, & Lynch, 2007; Rapp et al., 2007; van den Broek et al., 2005; van den Broek, White, Kendeou & Carlson, 2009). Effective interventions are those that influence readers' actual processes during comprehension, particularly at points where children's comprehension processes tend to break down. In doing so, they also affect the memory representation and understanding that children have after they listened to a text. The current studies show that questioning techniques can be adapted to very young children and can indeed affect their comprehension. These techniques therefore provide a promising starting point for the development of interventions aimed at fostering comprehension and inference-generation skills in children well before they start to read texts.



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