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Coherence monitoring by good and poor comprehenders in elementary school: Comparing offline and online measures☆

Anne Helder *, Linda Van Leijenhorst, Paul van den Broek

Institute of Education and Child Studies, Leiden University, The Netherlands

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A B S T R A C T

Central to children's reading comprehension is their ability to construct a coherent mental representation of a text. This study examined whether children with good and poor comprehending abilities (N = 74; 8–9, 10–11 years) differ systematically in their coherence-monitoring skills, and if such differences are age-related. Within each age group, poor comprehenders had greater difficulty reporting a coherence break after reading compared to good comprehenders; in addition, older children outperformed younger children. Coherence-break detection during reading did not differ between good and poor comprehenders nor between age groups. In all age and ability groups, accuracy after reading was related to coherence-break detection during reading. These results suggest that poor comprehenders' difficulties in coherence monitoring originate in encoding processes rather than in failure to detect coherence breaks during initial reading. Importantly, this was the case for children in both age groups.

1. Introduction

For children to succeed in school it is crucial that they are able to understand what they read. This requires that children master technical reading skills (learning to translate letter symbols into meaningful language) as well as comprehension skills (learning to construct meaning from a text). Despite the efforts of schools, approximately 25% of children do not reach the basic level of required comprehension skills at the end of elementary school (National Center for Education Statistics, 2011), even if many of these do possess sufficient technical reading skills (Cain & Oakhill, 2006; Catts, Adlof, & Weismer, 2006; Hulme & Snowling, 2009). Lacking adequate comprehension skills severely limits their ability to understand and learn from texts. In order to design effective interventions for these children, it is necessary to understand the development of cognitive processes underlying reading comprehension and to determine how these processes differ between successful and struggling comprehenders (Hulme & Snowling, 2011). In the current study we investigated the ability of good and poor comprehenders in middle and upper elementary school on an essential component of reading comprehension, the ability to monitor the coherence of an unfolding text.

Reading comprehension is a complex ability combining many cognitive processes (e.g., Hannon, 2012) that undergo changes in development, especially in the elementary school years (Ehri et al., 2001; Oakhill & Cain, 2007; van den Broek, 1997). Various theoretical models of reading comprehension processes have been proposed (McNamara & Magliano, 2009). Most of these models share the notion that successful comprehension requires a reader to construct a coherent mental representation, or situation model, of a text (e.g. Graesser, Singer, & Trabasso, 1994; Kintsch, 1998; van den Broek, 1994). A situation model of a text goes beyond the literal text because readers add semantic relations between parts of the text and between the text and their background knowledge. To construct such a representation, readers need to monitor the coherence of the text and of their emerging mental representation during reading and to recognize – and correct – any disruptions to coherence. Detection of potential incoherence during reading contributes to successful comprehension because it enables a reader to adapt his or her reading behavior to restore coherence when needed. For example, readers can look back in the text, reread parts of the text, or apply their background knowledge (Duke & Pearson, 2002). Conversely, if a reader fails to notice coherence breaks their representation will be less coherent and, hence, comprehension suffers. Thus, the extent to which children are able to monitor coherence as they proceed through a text is a crucial factor in their success (and failure) in reading comprehension.

Prior research has shown that there are both developmental and individual differences in the ability to detect coherence breaks. With regard to developmental differences, older children detect coherence

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* Corresponding author at: Institute of Education and Child Studies, Leiden University, Wassenaarseweg 52, 2333, AK, Leiden, The Netherlands.
E-mail address: a.helder@fsw.leidenuniv.nl (A. Helder).

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breaks more often than younger children do (Markman, 1979; Oakhill & Cain, 2007; Vosniadou, Pearson, & Rogers, 1988) –a pattern that continues well into adolescence (Hacker, 1997). With regard to individual differences, poor comprehenders have greater difficulty detecting coherence breaks in texts and, as a consequence, construct less coherent mental representations of a text than good comprehenders do (Cain & Oakhill, 2007; Garner, 1981; Oakhill, Hartt, & Samols, 2005).

Most studies on coherence break detection by children have used measures of semantic contradiction detection *after* reading was completed, that is, *offline*. For example, in one study 10–12-year-old children were asked to judge whether stories they just read made sense or not (Garner, 1981). In another study, 6–11-year-old children were asked to recall stories and indicate what it was about the story that did not make sense and to justify their responses (Vosniadou et al., 1988). In a study with older participants, 12–17-year-old children were asked to read texts and then underline parts of the text that did not fit (Hacker, 1997). To gain insight into the causes of such developmental differences and of difficulties that poor comprehenders at different ages experience, it is crucial to consider the execution of cognitive processes *during* reading, that is, *online*. Consideration of the processes during reading is not only important for theoretical models of reading comprehension and coherence monitoring but also for educational practice, to allow for the development of effective interventions. For example, if poor comprehenders' difficulty concerns the initial perception of a coherence break then optimal remediation would be different than if their difficulty concerns later stages of processing, where the reader adapts his or her reading behavior.

A powerful method that is used to investigate coherence monitoring during reading by adults involves measuring reading times in a self-paced contradiction paradigm (Albrecht & O'Brien, 1993; O'Brien & Albrecht, 1992; O'Brien, Rizzella, Albrecht, & Halleran, 1998). In this paradigm participants read narratives sentence-by-sentence on a computer screen in a self-paced manner. Readers are instructed to read for comprehension and answer questions that will follow; thus, they are not explicitly asked about possible contradictions. Reading times for each sentence are recorded. Some of the narratives contain a semantic contradiction between information presented early in the text and information presented in a target sentence later in the text. For example, in one text Mary is introduced as a vegetarian but later in the text she orders a cheeseburger (Albrecht & O'Brien, 1993). When reading times for target sentences from consistent narratives are compared to those from inconsistent narratives, proficient adult readers usually show a so-called inconsistency effect: processing inconsistent target sentences takes more time compared to processing consistent target sentences. The difference reflects online coherence break detection (Gerrig & O'Brien, 2005; O'Brien, Cook, & Gueraud, 2010). The contradiction paradigm has been used successfully to study online coherence break detection, including differences between good and poor comprehenders. For example, good and poor comprehenders showed an inconsistency effect when two pieces of inconsistent information were presented in adjacent sentences, but only good comprehenders continued to show an inconsistency effect when conflicting pieces of information were separated by intervening sentences. This has been observed for adults (Long & Chong, 2001) and for 10–12-year-old children (van der Schoot, Reijntjes, & van Lieshout, 2012).

By combining offline methods with online methods such as the contradiction paradigm, it is possible to gain insight into the points in processing where coherence-monitoring problems are most likely to originate. Incoming textual information is processed in several stages before it is incorporated in the reader's situation model or mental representation of the text as a whole (Cook & O'Brien, 2014; Isberner & Richter, 2014a; Singer, 2013; van den Broek, Young, Tzeng, & Linderholm, 1999). With regard to coherence monitoring, an important distinction is between the initial *detection* of a potential coherence break and subsequent *encoding* of such a coherence break into the reader's memory representation of the text. Detection of a coherence break during initial reading of a new text element results from a rapid validation of incoming information against prior text and/or background knowledge (Cook & O'Brien, 2014; Isberner & Richter, 2014b; Singer, 2013). Successful detection depends on the degree to which relevant information from earlier text and background knowledge is readily available in the reader's working memory at the time the new information is being processed and the efficiency of the matching process (Singer & Doering, 2014). Encoding of a coherence break, once detected, depends on factors such as the reader's standards of coherence, his or her comprehension strategies, and the efficiency of memory storage processes (e.g. Pressley & McCormick, 1995; van den Broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011).

The aim of the current study is to investigate good and poor comprehenders' ability to detect and encode coherence breaks in materials they read, and to determine if possible problems tend to originate during the initial detection or in the subsequent processing and encoding of a detected coherence break. We consider these questions for two age groups, 8–9-year-old and 10–11-year-old children, to determine if the source of coherence-monitoring problems may differ for different age groups. For the younger age group, reading development and instruction typically are centered around basic reading skills such as decoding, syntax, and vocabulary, with relatively little emphasis on comprehension of texts. For the older group, development and instruction center mostly around understanding of texts as a whole and on extracting knowledge from the texts (Best, Floyd, & McNamara, 2008). Thus, the selected age groups represent both sides of the transition from 'learning to read' to 'reading to learn' (Chall, 1996) although children engage in coherence building processes well before formal education starts (e.g. Bauer, 2002; Kendeou, White, van den Broek, & Lynch, 2009). In addition, because of the need to attend to basic processes the younger group may have relatively fewer cognitive resources available for comprehension processes such as coherence monitoring, whereas for the older group basic skills may be more automatized, leaving more cognitive resources available for coherence monitoring (Kendeou, Papadopoulos, & Spanoudis, 2012; Perfetti, 1985, 2007).

The logic of the current study is similar to that used by Zabrucky and Ratner (Zabrucky & Ratner, 1986, 1989, 1992) in a series of studies on elementary school children's ability to monitor whether they understand what they read. Following Baker (1985), these authors distinguished between comprehension-monitoring components related to the initial perception of coherence breaks (evaluation) and those related to the possible adaptation of reading behavior to restore comprehension (regulation). Elementary school children read short narratives that contained information that was either consistent or inconsistent with prior information from the text. A comparison of coherence monitoring by 8–9 and 11–12-year-old children, respectively, showed that after reading was completed (i.e., offline) the older children were more likely to report coherence breaks than were the younger children but that during reading (i.e., online) the younger and older children both detected coherence breaks (Zabrucky & Ratner, 1986). In subsequent studies, good and poor 11–12-year-old readers were compared. Results showed that offline, good readers were more likely to report coherence breaks than were poor readers but that both good and poor readers detected coherence breaks online (Zabrucky & Ratner, 1989, 1992). These findings suggest that differences in coherence-monitoring ability between these age groups and between good and poor readers in the older age group, do not originate in difficulties detecting coherence breaks during reading.

The current study extends the above research by investigating (a) whether children with good and children with poor reading-comprehension ability differ systematically in their coherence-monitoring skills at the detection and encoding stages and (b) if any such differences depend on age (8–9-years vs. 10–11-years-old). In addition, we consider the direct relation between online coherence break detection and subsequent encoding. Insight into this relation and whether it differs for children in different age and ability groups is

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