How to assess and improve children's reading comprehension?
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CHAPTER 1

GENERAL INTRODUCTION
Reading comprehension is one of the most important abilities children have to acquire during the upper grades in primary education (e.g., Mason, 2004; Spörer & Brunstein, 2009). Being able to read a text and understand its content is essential for participating in our society, since those skills are involved in many activities in daily life. It is therefore not surprising that reading comprehension is the most crucial predictor of later school success and a prerequisite for lifelong learning (e.g., Mason, 2004; Spörer & Brunstein, 2009). Since reading comprehension is such an important skill and many children have severe problems with it (Nation & Snowling, 1997), research on the improvement of reading comprehension is of great concern.

To improve primary school children’s reading comprehension, knowledge about the underlying skills of reading comprehension and about the processes that aid in the comprehension of texts is necessary. Also, insight into reading comprehension assessment is essential as reading comprehension tests are found to differ in the comprehension skills that are assessed and in the cognitive abilities that are required (e.g., Keenan, Betjeman, & Olson, 2008). Therefore, the first aim of this dissertation is to further investigate the assessment of reading comprehension. In particular, it will be examined how different types of reading comprehension tests differ in the skills that are required. A second aim of this dissertation is to assess the contribution of one specific ability to reading comprehension to gain further insight into the improvement of reading comprehension, that is, the knowledge and use of reading strategies. Assessing the influence of reading strategies on reading comprehension is relevant for educational practice.

Both the reading comprehension process as well as the cognitive and linguistic abilities involved in reading comprehension have received attention in research (e.g., Hoover & Gough, 1990; de Jong & van der Leij, 2002; Oakhill & Cain, 2012). There are several theoretical models to describe the process of text comprehension. These models represent a framework for the studies in this dissertation and will be considered first. Next, the underlying abilities of reading comprehension will be discussed. Although previous studies have shown that reading comprehension tests differ in their underlying abilities, consensus has not been reached about the different contributions these abilities make to different tests (e.g., Andreassen & Bråten, 2010; Keenan & Meenan, 2014). Thus, to gain further insight into the improvement of reading comprehension, more information about the assessment of
reading comprehension is essential. Moreover, it is unknown whether specific types of reading comprehension exist (e.g., Basaraba, Yovanoff, Alonzo, & Tindal, 2013; Davis, 1944). Therefore, in this dissertation, the underlying skills of different reading comprehension tests will be examined, as well as whether specific types of reading comprehension can be distinguished. If the underlying skills of reading comprehension differ depending on the type of test, this has implications for which test should be chosen to measure the effect of reading comprehension interventions and for diagnosing poor comprehenders.

One main aim is thus to focus on the underlying abilities and the assessment of reading comprehension. Another is to investigate the improvement of reading comprehension through training the knowledge and use of reading strategies, an important predictor of reading comprehension (e.g., National Reading Panel, 2000; Graesser, 2007). Although several studies have examined the effect of reading strategy training on reading comprehension, research on the relation between reading strategies and reading comprehension is scarce. To investigate whether reading strategies can be used to enhance reading comprehension, the relation between knowledge of reading strategies and reading comprehension will be first investigated. In addition, a longitudinal study will provide insight into the developmental relationships of reading strategies and reading comprehension. Finally, an intervention study will be carried out to investigate whether training of the knowledge and use of reading strategies is an effective method to enhance children’s level of reading comprehension.

THE READING COMPREHENSION PROCESS

Reading comprehension can be defined as a complex cognitive process that involves several cognitive and linguistic abilities. During reading a text, a mental representation of what the text is about is constructed. The process of comprehending a text has been interpreted in several theoretical models of reading comprehension. The construction-integration model (Kintsch, 1988; Kintsch & van Dijk, 1978) is the earliest and most influential model of text comprehension. In this model, three different mental representations of a text are distinguished, the surface level, the textbase, and the situation
model, and two phases, construction and integration. The surface level is a representation of the words in the text and their syntactic relations. The textbase represents the meaning of words and connections between sentences in a text. The situation model is a mental representation of what the text is about; it is an integration of the child’s prior knowledge and information presented in the text. For text comprehension, the activation of information from these representations in long term memory (construction phase) and the integration of these elements of information in working memory (integration phase) take place. These phases proceed in a cyclic way during the reading process. This cyclic process results in a mental representation of the meaning of a text, a situation model, that is often regarded as the ultimate goal of reading comprehension (Kintsch & van Dijk, 1978).

Another theoretical model of the reading comprehension process is the landscape model (van den Broek, Young, Tzeng, & Linderholm, 1999). This model describes text comprehension as a landscape of fluctuating activations of text elements. Due to limited memory resources, only a few text elements can be activated at the same time during text reading. Text elements from four different sources can be activated. These sources are the text that is read, the sentence directly before the sentence that is read, other sentences that have been read before, and background knowledge. Connections between text elements arise when two elements are activated at the same time. When relevant text elements are activated and connected, a coherent mental representation of the text is constructed.

In contrast to the construction-integration model and the landscape model, which target the entire reading comprehension process, several other theoretical models address specific aspects of text comprehension. For example, the resonance model mainly focuses on factors that are involved in the construction phase as described in the construction-integration model (Myers & O’Brien, 1998). This model was developed to explain the activation and reactivation of knowledge during text comprehension. In contrast to the resonance model, the constructionist model (Graesser, Singer, & Trabasso, 1994) focuses on the factors that influence the construction of relations between parts of the text, and parts of the text and background knowledge, that is, inference making, and not on other processes that take place during reading comprehension, such as monitoring, the ability to control the comprehension process (e.g., Oakhill & Cain, 2012). The event indexing model (Zwaan, Langston, & Graesser, 1995) even only describes processes that are involved in inferences
between parts of the text. This model does not involve the construction of inferences that go beyond the text and integrate background knowledge with information in the text.

The theoretical models of reading comprehension described above have different foci on the reading comprehension process. The overlapping goal of all models is to describe how a mental model of the text is constructed, or to explain a part of this process. These theoretical models of reading comprehension presume that several cognitive and linguistic abilities play a role in text comprehension. As such, these models form a theoretical framework for the studies in this dissertation.

THE UNDERLYING ABILITIES OF READING COMPREHENSION

Several cognitive and linguistic skills are involved in the construction of a mental representation of the text. The comprehension of a text starts with the understanding of single words (e.g., Verhoeven & Perfetti, 2008). First, the accurate and fast decoding of these words is necessary, that is, the phonological codes for the written words have to be retrieved from memory. In addition to phonology, semantic information at the word level is required, since the meaning of single words is a prerequisite of text understanding. Next to these lower-order abilities, higher-order comprehension skills are involved in text comprehension (e.g., Kendeou, van den Broek, Helder, & Karlsson, 2014). With these higher-order abilities, the meanings of words and sentences in the text are integrated in a situation model of the text. The processing and storage of information during the reading of texts involves working memory (e.g., Daneman & Merikle, 1996). A working memory process that might especially be important for reading comprehension is updating ability, since the process of incorporating new information into the existing mental representation of the text also necessitates updating.

In sum, several underlying skills are involved in reading comprehension, such as reading fluency, vocabulary, and working memory processes. However, the contribution of these abilities has been shown to depend on the type of reading comprehension measure that is used (e.g., Cutting & Scarborough, 2006; Keenan et al., 2008; Kendeou, Papadopoulos, & Spanoudis, 2012; Nation & Snowling, 1997).
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READING COMPREHENSION ASSESSMENT

Typically, reading comprehension is assessed by asking children to read a text and answer questions about it. For example, the LOVS test (Leerling- en Onderwijs Volgsysteem, [System for the Longitudinal Assessment of School Achievement]) is a standardized Dutch test (Cito, 2008) that consists of narrative and expository texts of medium length, and contains literal, inferential, and evaluative multiple-choice questions. The Gates-MacGinitie reading comprehension test is a standardized American test that also consists of medium passages with different genres and multiple-choice questions that require the understanding of information that is explicitly or implicitly provided in the text (MacGinitie, MacGinitie, Maria, & Dreyer, 2000). Other tests that are used to assess reading comprehension might differ to a large extent from these standardized reading comprehension tests. For example, the PIAT requires children to read single sentences and to choose the picture that best expresses the meaning of that sentence (Dunn & Markwardt, 1970; Keenan et al., 2008). As another example, the CBM-Maze test is a timed cloze test that is also often used as a measure for reading comprehension (Deno, 1985; Espin & Foegen, 1996). In this test, every seventh word is removed and children are required to choose the correct word from three alternatives, one correct and two clearly incorrect alternatives.

Although reading comprehension tests might differ (to a large extent), reading comprehension tests are used interchangeably because these tests are all assumed to measure the same construct, that is reading comprehension. However, several studies have shown that reading comprehension tests can differ in their underlying skills (e.g., Cutting & Scarborough, 2006; Keenan et al., 2008; Kendeou et al., 2012; Nation & Snowling, 1997). For example, the Gates-MacGinitie is known to rely on both word reading ability and language comprehension skills (Cutting & Scarborough, 2006; Tilstra, McMaster, van den Broek, Kendeou, & Rapp, 2009). The CBM-Maze test, however, relies heavily on word reading skills, whereas the reliance on language comprehension skills has never been investigated (Kendeou et al., 2012). The language comprehension demands of the CBM-Maze test should be further investigated to continue the use of this test as a measure for reading comprehension. More generally, studies that focused on differences between reading comprehension tests are inconsistent about the abilities that are involved in those
tests (e.g., Andreassen & Bråten, 2010; Keenan & Meenan, 2014). Therefore, in this dissertation, differences between several reading comprehension tests will be examined.

Differences between reading comprehension tests have often been attributed to specific text and question types. However, it is not clear yet whether these specific types of reading comprehension can be distinguished. Very early studies on reading comprehension revealed that reading comprehension is a single skill, or, in other words, a one-dimensional ability (e.g., Davis, 1944; Spearritt, 1972; Thorndike, 1973). This implies that specific reading comprehension measures do not exist. In contrast, several current studies implicitly assume the existence of types of reading comprehension, depending on the text and question types involved and, as a consequence, take reading comprehension as a multi-dimensional construct (e.g., Keenan et al., 2008). It is essential to further investigate the dimensionality of reading comprehension, since that has important implications for reading comprehension education and for diagnosing poor comprehenders.

**THE IMPROVEMENT OF READING COMPREHENSION**

To improve children’s reading comprehension, several higher-order processes that aid the construction of a situation model of the text can be targeted for intervention, such as monitoring - the ability to control the comprehension process - , and inference making - the construction of relations between parts of the text, and parts of the text and background knowledge - (e.g., Oakhill & Cain, 2012). Two types of inferences can be distinguished (e.g., McNamara & Magliano, 2009). In bridging inferences, children relate information from the current sentence to information from prior sentences. In elaborative inferences information from the current sentence and background knowledge are integrated. The number and type of inferences, in turn, is influenced by reading strategies (e.g., Graesser, 2007). For example, a reader who tries to find specific information in a text will create less, and less complex inferences than a reader who aims at entirely understanding a text. The knowledge and use of reading strategies is thus also considered as an important process involved in reading comprehension. Accordingly, such strategies might be stimulated to improve reading comprehension.
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READING STRATEGIES

Reading strategies can be defined as the cognitive and metacognitive processes that are used to better understand a text (Cromley & Azevedo, 2006; Graesser, 2007). For example, when a reader does not understand a specific word in the text, the reader might use strategic behavior to fix this comprehension gap. That is, the reader looks up the word in a dictionary, reads the definition of the word, rereads the sentence, and tries to comprehend it. Abundant evidence has shown that reading strategies are important for the comprehension of a text (e.g., Mason, 2004; National Reading Panel, 2000). First, poor comprehenders use simpler and less efficient reading strategies than good comprehenders, and they are not able to fluently apply reading strategies. Second, the training of reading strategies has been found to be an effective method to improve reading comprehension.

Despite the importance of reading strategies for reading comprehension, as shown in previous research (e.g., National Reading Panel, 2000), studies on the relation between reading strategies and reading comprehension are scarce. In particular, there is a lack of studies that examined the developmental relationships between knowledge of reading strategies and reading comprehension. Although intervention studies suggest that reading strategies affect reading comprehension, there are no studies that have examined the possibility of a reciprocal relation.

Even though there are hardly any studies on the developmental relation between reading strategies and reading comprehension, the training of reading strategies is an often used method to enhance reading comprehension skills (e.g., National Reading Panel, 2000; Solis et al., 2012). The majority of the studies on reading comprehension strategy interventions focused on small groups of poor comprehenders and older children and often, strategy interventions are provided by trained test assistants (e.g., Brand-Gruwel, Aarnoutse, & van den Bos, 1998; Hagaman & Reid, 2008; Mason, 2004). In contrast to these older children, young children who just started with reading comprehension education all have to acquire knowledge of reading strategies. In addition, observations of reading comprehension lessons revealed that there is little explicit instruction on reading comprehension and hardly any guidance about how to apply reading strategies (e.g., Mason, 2004). Therefore, it is
important to examine the effect of strategy interventions that are provided by the teacher to entire classes of beginning comprehenders.

**OUTLINE OF THIS DISSERTATION**

The general aim of this dissertation is to gain further insight into the assessment and improvement of children’s reading comprehension. The studies in this dissertation mainly focus on Dutch fourth-grade children from regular elementary schools.

The studies reported in Chapters 2, 3, and 4 address the assessment of reading comprehension. In Chapter 2, the specific contribution of two higher-order abilities to two Dutch reading comprehension tests, the LOVS and the CLIB tests, in a sample of almost 200 fourth graders is examined. Despite the clear role of updating and reading strategies in theoretical models of reading comprehension, studies on the relations of updating ability and reading strategies, with reading comprehension are scarce (e.g., Cain, 1999; Carretti, Cornoldi, de Beni, & Romanò, 2005; Palladino, Cornoldi, de Beni, & Pazzaglia, 2001; Samuelstuen & Bråten, 2005). In this chapter, the specific contribution of updating ability and knowledge of reading strategies to reading comprehension is examined. Two different reading comprehension tests are used to test whether the results can be generalized across tests.

In Chapter 3, differences in the demands of two American reading comprehension tests are investigated, the Gates-MacGinitie and the CBM-Maze tests. The Gates-MacGinitie test is a reliable measure of reading comprehension that relies both on word reading and language comprehension skills (Cutting & Scarborough, 2006; Tilstra et al., 2009). The CBM-Maze test has often been used as a formative measure of reading comprehension in schools (e.g., Kendeou & Papadopoulos, 2012; Kendeou et al., 2012). It is already known that the CBM-Maze test highly taps on word reading skills (Kendeou et al., 2012; Gellert & Elbro, 2013). However, the role of language comprehension skills has never been investigated. To continue the use of the CBM-Maze test as a good proxy for reading comprehension, its language comprehension demands should be investigated. In this study, the demands of the CBM-Maze and the Gates-MacGinitie tests are compared in almost 300 children. Since it is
commonly known that the demands of reading comprehension change over time, the current study focuses on children from elementary, middle, and high school.

In Chapter 4, the structure of a large pool of reading comprehension items is tested by investigating the existence of specific factors of different text and question types in a sample of almost 1000 fourth graders. Differences between reading comprehension tests have often been attributed to specific text and question characteristics (e.g., Andreassen & Bråten, 2010; Basaraba et al., 2013; Eason, Goldberg, Young, Geist, & Cutting, 2012; Keenan et al., 2008; Keenan & Meenan, 2014; Miller et al., 2014). However, the results of these previous studies are contradictory. The equivocal results of previous studies might be explained by the implicit and possibly not valid assumption of specific reading comprehension tests differing according to text and question types. However, the existence of such specific factors has never been tested in a large item pool. In this chapter the dimensionality of reading comprehension is tested by investigating the existence of specific factors of different text and question types in a large pool of reading comprehension items. In addition, the relations of word reading speed, vocabulary, and working memory, with specific text and question type factors of reading comprehension are examined.

In Chapters 5 and 6, the focus is mainly on the improvement of reading comprehension via the acquisition of the knowledge of reading strategies and practice in the use of reading strategies. The aim of Chapter 5 is to investigate the developmental relations between knowledge of reading strategies and reading comprehension. To our knowledge, there are no previous studies that examined the longitudinal relations between reading strategies and reading comprehension. In this study, approximately 1000 children are tested in the beginning of Grade 4 and at the end of Grade 5. The unique effects of knowledge of reading strategies and reading comprehension at the beginning of Grade 4, on knowledge of reading strategies and reading comprehension at the end of Grade 5 are investigated.

In Chapter 6, the effect of a classroom-based reading comprehension strategy intervention is examined. Several previous studies have shown that many reading strategy interventions enhance children’s level of reading comprehension (e.g., Brand-Gruwel et al., 1998; Hagaman & Reid, 2008; National Reading Panel, 2000; Spörer, Brunstein, & Kieschke, 2009). Most of these studies were focused on small groups of poor comprehenders. The
current study focuses on a group of beginning comprehenders, who all may benefit from the intervention. Therefore, trained teachers provide an intervention to their entire class using reciprocal teaching. To our knowledge, this is one of the first studies that includes these features in an intervention. The effect of the intervention is examined on measures for knowledge of reading strategies and reading comprehension.

Finally, in Chapter 7, the results of the aforementioned chapters are integrated and discussed. Theoretical and practical implications and suggestions for future research are given.