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MOVING BEYOND WORDS

Supporting Text Processing Using a Situation Model Approach

Lisanne T. Bos

Leescommissie (Thesis Committee)

prof. dr. Jos Beishuizen (Vrije Universiteit Amsterdam)

prof. dr. Eliane Segers (Radboud Universiteit Nijmegen)

prof. dr. Christine Espin (Universiteit Leiden)

prof. dr. Ted Sanders (Universiteit Utrecht)

dr. Jurgen Tijms (Universiteit van Amsterdam & IWAL Instituut voor Leerproblemen)

Paranimfen

Marcella van Beusekom

Paula Gromann

MOVING BEYOND WORDS: Supporting Text Processing using a Situation Model Approach

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VRIJE UNIVERSITEIT

MOVING BEYOND WORDS

Supporting Text Processing Using a Situation Model Approach

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
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door

Lisanne Thea Bos

geboren te Haarlem

promotor: prof.dr. A.C. Krabbendam
copromotoren: dr. M. van der Schoot
dr. B.B. de Koning

Carefully
I held the book
to my ear.

cannons roar
galloping horses
screaming princesses
in distress.

Yeah, this is what
I was looking for.

Loesje

* Translated from: Loesje, Postbus 1045, 6801 BA Arnhem

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Chapter 1: General Introduction



Teaching children to comprehend what they read is considered one of the most important objectives of primary education (Lancia, 1997; Oatley & Olson, 2010). Yet many school-age children struggle to acquire reading skills and experience difficulties in understanding texts. Internationally, more than thirty percent of fourth graders and twenty-four percent of eighth graders cannot read at a basic level (National Center for Education Statistics, 2011). This is also the case in the Netherlands where periodic surveys of reading show similar results (van Berkel, Krom, Heesters, van der Schoot, & Hemker, 2007; van der Schoot, 2008;). Additionally, children show a decrease in the motivation to read from Grade 2 onwards (Bos, De Koning, & van der Schoot, 2014; Stoeldraijer & Verwooy, 2007). These results are alarming as reading comprehension is crucial for the academic success of a child. That is, reading comprehension is not only a crucial aspect for specialized skills during the reading class, but it is also important for the understanding of questions in other areas such as mathematics, geography, and history. In a broader sense, reading comprehension skills are fundamental to children's future working careers, daily activities, and social functioning in our increasingly text-based and complex information-communication society (Snow, 2002).

It is largely unknown what actually underlies these problems, but several explanations can be offered. A possible explanation is that books are classified to a certain reading comprehension level (in Dutch: AVI-niveau). This can have a negative influence on the reading motivation of children, because the texts are not classified on experience but rather on technical reading skills. Another explanation for this phenomenon is that the approach in reading comprehension courses is focused on the exercise of individual reading strategies, whereby the importance of a challenging reading context is ignored. The risk, therefore, is that students will use the strategy only as a goal and not as a useful tool, and hence the reading motivation of the students will drop (PPON, 2007).

These issues have led to public concern and policy initiatives that emphasize the need for effective approaches for teaching reading comprehension. Driven by these aspects, this thesis is dedicated to translational research in the field of reading comprehension using the Situation-Model Framework as foundation to the presented research questions.

Situation Model Framework

It is by now well-established in reading comprehension research that a reader's mental representation of text consists of different levels of comprehension (Kintsch, 1988; Zwaan & Radvansky, 1998). Within the Situation Model Framework, three levels of representation are distinguished: surface-based representation, text-based representation, and situation model representation (Kintsch, 1994, 1998; Kintsch & van Dijk, 1987). The surface-based representation contains the literal words and clauses that are mentioned in the text. The text-based representation contains the meanings of the words, clauses, and sentences, as well as their mutual relations that are explicitly presented in the text. The situation model representation is an integrated, coherent, non-verbal, mental representation of the state of affairs described in a text (Zwaan & Radvansky, 1998). In fact, the situation model integrates the propositional content of the text with information from prior knowledge (Stine-Morrow, Gagne, Morrow, & DeWall, 2004). When trying to comprehend texts, the situation model is gradually constructed by continuously monitoring information from different situational dimensions (space, time, protagonist, causation, and intentionality; Zwaan, Langston, & Greasser, 1995; Zwaan, Magliano, & Greasser, 1995). By integrating information from these dimensions, readers gradually update their representation and put together a coherent and richly connected situation model. In contrast to the surface-based and text-based representations, the situation model representation is not restricted to the text information (Kintsch, 1994, 1998; Kintsch & van Dijk, 1987). Situation models, therefore, constitute the level of text representation which is associated with deep processing (van der Schoot, Horsley, & Lieshout, 2010).

In summary, a situation model is a non-verbal mental representation of the text as a whole that reflects the reader's understanding that goes beyond the text. In other words, it is a mental representation wherein the text information is integrated with the reader's world knowledge and what the reader already knows from the topic (van der Schoot et al., 2010). Hence, the situation model will not only help to gain a deeper comprehension of text, but it also ensures that the reader is involved and connecting with the text (Van de Ven, 2009). That is, constructing a situation model helps readers to experience and vividly represent the situation described in the text (De Koning & van der Schoot, 2013, 2014). As such, the situation model is retained in memory much longer than the text-based and the surface representation. These

aspects make that readers can benefit from the construction of situation models both in terms of reading comprehension and reading motivation.

Reading Comprehension: Situation Model Processes

The studies included in this thesis focus on the construction of situation models from narrative text by investigating the skills and strategies that are crucial for the construction and revision of the situation model, namely mental simulation, comprehension monitoring, and inference making.

Mental Simulation

As just stated, language comprehension necessarily involves the construction of a mental representation (Zwaan & Radvansky, 1998), as such it can be considered the infrastructure of the construction of the situation model. Inspired by embodied theories of language comprehension, the view that situation-model representations formed during language comprehension involve sensory, motor, and emotional information is gaining popularity (De Koning & van der Schoot, 2013; van den Broek, 2010; Zwaan, 2015). This observation has now been supported by numerous behavioral and neuroimaging studies (e.g., Louwerse, Hutchinson, Tillman, & Recchia, 2015; Pulvermüller, 2005). In capturing the meaning of a text, readers mentally simulate the described situations and events through the reactivation of previously acquired real-world perceptual, motor, and affective experiences (Barsalou, 1999, 2008). It follows that, in such an embodied view to language comprehension, the neural circuits involved in understanding sentences are of the same kind as those involved in having actual sensory and motor experiences. Consider, for example, the situation that you make a cup of coffee. During the actual experience, patterns of brain activation are formed across multiple modalities, which are then stored in your memory (e.g., how your coffee smells, looks, feels). Later on, when retrieving the stored experience from the long-term memory during reading, the multimodal representation captured during the actual experience is reactivated to reproduce how the brain represents perception and action.

In sum, according to embodied theories of language comprehension, a deep understanding of text involves a mental simulation of described events and actions by reactivating and integrating traces of earlier experiences from multiple perceptual and motor modalities in the brain that were recruited when the actual experience was

acquired (Barsalou, 1999). So far, most of the research on mental and motor simulations was fundamental in nature and done with adults (Wellsby & Pexman, 2014). Hence, relatively little is known about children's mental simulations during reading and how, from a more applied perspective, mental simulation of text information can be stimulated. In this thesis, both of these aspects will be addressed by investigating how to enhance children's mental simulation skills supportive to situation model construction and hence deeper comprehension of text.

Comprehension Monitoring

Besides mental simulation, comprehension monitoring is a reading comprehension strategy pivotal to situation model processing, in particular the updating of a situation model. Comprehension monitoring refers to the ability of readers to evaluate their understanding of a text. Readers engaging in comprehension monitoring processes continuously ask themselves if what they are reading makes sense. Rephrasing this in situation model updating terminology, skilled readers constantly check for themselves to what extent new text information is consistent with the information already present in their current situation model. If it is, the new information can be readily incorporated into the evolving situation model. If it is not, readers are required to resolve the inconsistency by using repair strategies to make sure their situation model corresponds to the described situation and so restore comprehension.

The ability of a reader to be aware, while reading, whether a text still makes sense or not as well as adequately adapting one's cognitive processing accordingly is central to comprehension monitoring, and more generally reading comprehension. Particularly, monitoring the different dimensions that a situation model contains during reading is crucial in achieving deep-level comprehension (Wassenburg, Beker, van den Broek, & van der Schoot, 2015). Related to this, it has frequently been argued that it is this comprehension monitoring ability which distinguishes skilled readers from less skilled readers (McNamara, Ozuru, Best, & O'Reilly, 2007; Pressley, Borkowski, & Schneider, 1987). Yet, whilst there is an increasing body of research on comprehension monitoring and its relevance for situation model construction, it remains largely unclear how we can encourage the usage of this strategy to achieve an intelligible situation model. In this thesis, we therefore will aim at teaching children monitoring strategies required for situation model updating. More

specifically, we will test an inconsistency-detection training developed to target comprehension monitoring strategies during reading.

Inference Making

Another central aspect of situation model construction is the need for coherence (McNamara & Magliano, 2009; van den Broek et al., 2011; van Silfhout, Evers-Vermeul, & Sanders, 2014). Establishing coherence does not come naturally for many readers, given that texts often contain implicit information, semantic vagueness and ambiguities, or temporal, spatial and causal discontinuities which may result in comprehension problems (e.g. Zwaan, Magliano, & Graesser, 1995). That is, readers are not confronted with complete and cohesive descriptions of narrative situations and therefore need to engage in inferential processes to construct a coherent situation model. To supplement their situation model with inferences readers can draw upon prior knowledge and/or textual clues in an attempt to obtain sufficient coherence (Cain & Oakhill, 2007; van den Broek & Espin, 2012). This helps readers to infer what is implied, resolve vagueness and ambiguities, or fill in gaps in time and space or missing causal relations between text events. In line with this, making inferences to construct a coherent situation model appears to be associated with deep processing of text. In general, situation model construction and inference generation are said to have a mutual and interactive relationship; inference making supports situation model construction, and situation models facilitate inference generation (e.g. Graesser, Wiemer-Hastings, & Wiemer-Hastings, 2001; Rickheit, Schnotz, & Strohner, 1985). In this thesis, we will focus on the first direction of influence that from inference generation to situation model construction. More in particular, we will design and test a training program embedded within the situation model framework to enhance children's inference making skills supportive to situation model construction and hence deep-level comprehension of text.

Aims

From the above theoretical and empirical background, it becomes evident that mental simulation, comprehension monitoring, and inference making are important strategies involved in understanding text at the situation model level. In the past years, reading comprehension researchers have made much progress in terms of fundamental empirical work on the use, role, and effectiveness of these component processes, or strategies, in relation to the construction of a situation model from text.

However, so far relatively little research has focused on how we can encourage the construction of a situation model. As such, the question as to how we can teach children to effectively construct situation models from text has mainly been unresolved. Therefore, this thesis primarily aims at bringing forth not only a significant theoretical stance, but also at fulfilling a practical contribution to the field of reading comprehension. In sum, the main goal was to investigate the influence of situation model construction on reading comprehension and how we can stimulate this construction. Another aim of this thesis was to investigate to what extent situation models play a role in other primary school subjects than reading comprehension. In doing so, we particularly looked at whether situation models can serve a functional role in producing, rather than understanding, text (i.e., writing a narrative). This extends the research on situation models in a novel direction and explores the applicability of the situation model framework to other disciplines.

Approach

The research presented in this thesis was conducted using an experimental approach. This yielded behavioral data which gained insight into both the end-product of the reading process (e.g., reading comprehension scores) and the processes leading to this end-product (e.g., use of the learned reading comprehension strategies). In all studies participants were primary school children (Grades 3-6) who were tested at their school, except for Chapter 6 where college students were tested in a more controlled laboratory setting. Throughout the studies, situation model theory was used as the main theoretical framework in which the studies were set-up and interpreted.

The three intervention studies reported in Chapters 2 through 4 had a similar design, which enables a direct comparison between the effectiveness of the three situation model focused strategies. That is, the studies employed a pretest-posttest control group design in which the independent variable was training group (mental simulation, inference making, or comprehension monitoring vs. control) and the dependent variables were reading strategy use (i.e., pre- and posttest scores on tests measuring mental simulation, inference making, and comprehension monitoring), general reading comprehension level (measured by the CITO reading comprehension test), and reading motivation. Pre- and posttests consisted of different versions of the same tests. Children from Grades 3 and 4 received training in just one of the three

reading comprehension strategies. Each strategy was taught in a 4-week training course containing 8 lessons. Training occurred in groups of 5-6 children and consisted of direct instruction, modeling, guided practice, and individual practice. The control group followed the school's regular reading comprehension curriculum. Several individual difference measures such as intelligence, decoding skill, vocabulary, working memory, visuo-spatial abilities, socioeconomic status and home literacy environment were included as control variables.

Chapter Overview

Chapter 2 investigates the effectiveness of a reading comprehension intervention study aimed at supporting mental simulation skills. Specifically, in the mental simulation training it was tested to what extent teaching readers to (1) connect their perceptual, motor, and emotional experiences to the text, and (2) mentally simulate visual and motor information that is implicitly described in a text, facilitates reader's situation model construction and hence deep-level comprehension of text. Use of the learned reading comprehension strategy was examined with the sentence-picture verification task and the sentence-sensibility judgment task.

Chapter 3 reports on the effectiveness of a reading comprehension intervention study for teaching comprehension monitoring strategies. The developed inconsistency-detection training specifically focused on situation model updating and aimed at teaching readers to maintain and restore comprehension during reading. To this end, children were trained to pay attention to the different situational levels (time, space, causation, intentionality, and protagonist) and also to find inconsistencies in the text. Use of the learned reading comprehension strategy was examined with the inconsistency-detection paradigm.

Chapter 4 describes the results of the reading comprehension intervention study focusing on inference making. The inference making training aimed at enhancing readers' inference making skills in order to construct a coherent situation model. It addressed the source (text-based versus knowledge-based), type (necessary versus unnecessary for (re-) establishing coherence), and depth of an inference (making single lexical inferences versus combining multiple lexical inferences), as well as the

type of searching strategy (forward versus backward). Use of the learned reading comprehension strategy was examined with the probe recognition task.

In **Chapter 5**, the question is addressed whether the construction of a situation model also supports, next to comprehension, the production of text. This was approached by asking children to engage in writing a creative narrative and investigating their ability to construct a situational and sensory rich situation model. Using path analyses, these representational abilities of children and the narrative descriptions derived from their text were related to the children's creative writing outcome.

Chapter 6 takes a more fundamental perspective at mental simulation of text information during reading. Specifically, it directly investigates within a single study to what extent different implied visual characteristics of described objects (i.e., shape, color, size, orientation) are mentally simulated during sentence comprehension. In doing so, this study aims to provide insight into whether the four investigated visual object properties are mentally simulated to the same extent and whether they share a common underlying mechanism.

Finally, in **Chapter 7**, the findings obtained from the research presented in Chapters two through six will be discussed in light of the aims of this thesis. Moreover, practical implications of the findings will be presented.

Chapter 7: Concluding Remarks



The research in the present thesis was motivated by the alarming findings regarding primary school children's poor reading comprehension performance and declining reading motivation. In line with the increasing need for effective approaches for teaching reading comprehension, the main goal was to develop and test reading strategy trainings aimed at improving reading comprehension and reading motivation. To ensure the trainings were theoretically sound, they were set up within a well-known cognitive theory of reading comprehension, namely the Situation Model framework. In particular, the trainings targeted the situation model strategies mental simulation (Chapter 2; also see Chapter 6 for a more fundamentally-oriented study on mental simulation that can be used to inform future trainings), comprehension monitoring (Chapter 3), and inference generation (Chapter 4), which are associated with deep-level text comprehension. Additionally, this thesis also investigated the extent to which the situation model framework provides a useful approach for understanding children's ability to produce, rather than comprehend, text (Chapter 5). Together, having a specific focus on narrative text, this thesis makes an important contribution to translating what is known from basic reading comprehension research to classroom practice at the primary school level. In the following, the main findings will be further discussed and recommendations for educational practice and future research will be provided.

Getting From the Text to the Situation Model

The findings of the training studies (Chapters 2-4) showed that all of the three situation model strategies (i.e., mental simulation, comprehension monitoring, and inference making) effectively influenced children's processing of written text (see Table 1). First, looking at reading comprehension strategy use, children who had received the comprehension monitoring training or the inference making training showed a significant improvement of posttest relative to pretest performance on respectively the inconsistency detection task or the probe verification task. Children in the control group, who followed their regular reading comprehension curriculum, did not show evidence of improved performance on these tasks. So, only children who were taught the comprehension monitoring skills or inference making skills made better and more frequent use of these skills during reading. Hence, they were better able to understand the text at the situation model level. For the mental simulation training there was no such significant pre-to-posttest gain, and hence improved strategy use, was observed regarding visual simulation (i.e., sentence-

picture verification task) and motor simulation (sentence-sensibility judgment task). In sum, two out of the three situation model strategy trainings led to improved use of the trained strategy.

Second, next to a more effective use of the trained reading skills, all three situation model strategies resulted in improved general reading comprehension levels as assessed by a standardized, normed reading comprehension test (i.e., CITO reading comprehension test). So, in each of the three situation model strategy trainings children were able to transfer the trained reading skills to general reading comprehension. The gains observed for these experimental training groups (roughly between +6.5 and +9.5 CITO-points) was significantly larger than the improvements made by children in the control training (roughly +2 CITO-points). Third, in correspondence with these findings, the mental simulation training, the comprehension monitoring training, and the inference making training also resulted in increased reading motivation. Children in these trainings indicated that they enjoyed reading more after the training than before the training. Children in the control training did not show this effect. Together, the three situation model strategy trainings led to improved general reading comprehension performance and increased reading motivation.

Table 1
Overview of the results of the intervention studies

	Strategy use	General reading comprehension	Reading motivation
Mental simulation	✘	✓	✓
Comprehension Monitoring	✓	✓	✓
Inference making	✓	✓	✓

From these findings, it can be concluded that it is possible to encourage children to construct a situation model during reading and that this helps them to gain a deeper understanding of the text and to experience reading as a more joyful activity. The reading comprehension strategy trainings described in this thesis are also illustrative of how situation model-focused trainings can be effectively designed. More broadly,

the presented findings demonstrate that the situation model framework provides a solid and suitable framework for developing an intervention aimed at supporting reading comprehension and reading motivation in primary school children. Thereby, this thesis concurs with and extends an emerging body of research that stresses the importance of applying theoretical and empirical findings from cognitive science to develop reading comprehension interventions that are feasible for classroom use (e.g., McMaster et al., 2015). The importance of this contribution is underscored by the increasing awareness that strengthening the connections between theory and practice is needed to build effective reading comprehension interventions (e.g., McKeown, Beck, & Blake, 2009).

Getting From the Situation Model to the Text

This thesis also provides a first insight into the interconnections between situation models and the production of a narrative text. The results from Chapter 5 show that abilities involved in constructing a situation model from texts are also relied upon when asked to write a creative story. More specifically, children's ability to construct a sensory rich situation model appeared to directly influence their creative writing outcomes. The extent to which children can construct a situational mental representation indirectly influenced creative writing outcome through the amount of narrative descriptions they produced. Together, these factors explained 37% of children's creative writing outcomes. From these findings, it can be concluded that situation models and the processes giving rise to them serve a functional role in writing a narrative. In other words, situation models not only appear to help children in the *comprehension* of text but also in the *production* of text. Or, translating this to the school situation, children rely on situation model processes for both the subjects reading and writing. This nicely fits the increasing awareness that situation models are involved in other school subjects than just reading. According to Boonen, van der Schoot, van Wesel, de Vries, and Jolles (2013), for example, situation model construction is at the core of problem solving success in mathematics. Children who fail to accurately represent the problem situation that is hidden in a mathematical word problem in their situation model experience difficulties in trying to provide the correct answer to the problem. Evidently, the findings of this thesis extend the research on situation models in a novel direction (i.e., writing) and add to the notion that the situation model framework is applicable to multiple school subjects.

Implications for Education

The results of the studies described in this thesis have direct implications for educational practice. Constructing situation models heavily depends on non-linguistic representational abilities to represent what the text is about. The findings from Chapters 2-4 indicate that the situation model strategies mental simulation, comprehension monitoring, and inference making all effectively contribute to such a visuospatial, multisensory mental representation of the situation that is described in a text, and hence reading comprehension. Generally, this connects to discussions on whether the present school system in the Netherlands puts too much emphasis on text-based and verbal-linguistic (e.g., summarizing, questioning) and too little emphasis on visuospatial learning and information processing strategies. The results of the studies presented in this thesis reinforce the idea that higher-order representational and imagery skills should be given a far more prominent role in reading comprehension instruction. This idea is supported by neurocognitive and psychological science wherein it has for example been shown that visual and motor experiences derived from actual interactions with the environment are involved in understanding text (Barsalou, 2008). Importantly, the findings from Chapter 2-4 suggest that using situation model strategies can already pay off in terms of immediately improved reading strategy use, reading comprehension, and reading motivation within a relatively short period of time (i.e., four weeks). Whether or not even more progress can be made with a prolonged training period and/or to what extent the obtained training effects are retained over time remains to be investigated in future research.

The findings of the reported intervention studies also give rise to some more specific recommendations. First, it seems relevant to stimulate children to connect the text they are reading to their own sensory, motor, and emotional experiences. Taking such a 'mental leap into imagined worlds' (Zwaan, 1999), in which readers can see, feel, hear, and 'act out' the described situation, helps readers to experience the story as if they were actually part of it. Besides mentally simulating explicitly described information, readers also seem to benefit from being encouraged and taught to simulate implicitly described information (e.g., simulating a bird with its wings outstretched instead of drawn in when reading the sentence "He saw the bird in the sky"). The findings from Chapter 6 provide a further specification for this recommendation. It showed that readers experience more difficulties to simulate the

orientation of an object as implied in a sentence (e.g., He put the screw in the wall/ceiling) than simulating an object's implied shape (e.g., He saw the egg in the box/skillet), color (e.g., He saw the bear in the woods/at the North Pole), and size (e.g., he saw the statue in the garden/windowsill). Future empirical and/or practical interventions aimed at improving mental simulation skills supportive to reading comprehension should take this effect into account. All in all, helping readers to 'mentally experience' the described situation during reading provides an innovative approach for teachers as not much attention is currently being paid to reading as a sensory experience (De Koning & van der Schoot, 2014).

Second, stimulating readers to make connections between the different elements described in the text as well as connecting the text to their knowledge of the specific topic appears to enable children to move beyond the text and actually develop a deeper understanding of the described situation. Reserving room for activating prior knowledge and teaching children how to use this knowledge for the sake of reading comprehension during reading comprehension lessons thus seems relevant. Also, encouraging readers to search for words or phrases in the text that can be meaningfully linked warrants attention. These aspects likely avoid misunderstandings of the text, aids readers in overcoming incoherencies, enables them to flexibly fill in spatial, causal, and temporal gaps, or assists them in simply enriching the evolving situation model that they construct during reading.

Third, it appears important to stimulate children to continuously monitor their comprehension, that is, check for themselves whether they still understand the text. It seems useful to make readers aware that when updating their situation model of the text with new incoming information, they should be sensitive to whether or not this information is consistent or inconsistent with their current situation model. A training specifically focused on detecting inconsistencies appears helpful in this regard. Moreover, such a training targeting all situational dimensions (time, space, causation, intentionality, protagonist) seems conducive to teaching readers inconsistency detection skills. Nevertheless, in a recent study Wassenburg, Beker, van den Broek, and van der Schoot (2015) showed that readers particularly experience difficulties in detecting temporal and spatial discontinuities in a text. Therefore, it could be argued that extra attention should be devoted to these dimensions in an inconsistency detection training.

Besides the implications stressing the importance of stimulating situation model construction for improving text comprehension, the results reported in Chapter 5 also emphasize the relevance of situation models in writing assignments. Arguably, writing effectively depends upon having flexible access to context-relevant information in order to produce texts. In this respect, the “situatedness” and “sensory richness” of children’s situation model appear relevant factors to take into account. Whereas situatedness seems useful for laying the foundation for the story in terms of the dimensions (e.g., location, time) along which the story is built, sensory richness influences the extent to which this foundation can be filled in or enriched (De Koning & van der Schoot, 2014; Zwaan, 2015). So, for purposes of guiding the writing process or supporting writing skills teachers should pay attention to both of these aspects while clearly explaining the functions of each. Particularly children who need further assistance or training to develop and use situational and sensory rich situation models might be encouraged to explicitly draw upon their imagination. Doing so might help them to produce richer and more lively texts.

Finally, the combination of findings regarding the role of situation models in the comprehension and production of text provides another, more general, implication for teaching reading comprehension and writing skills. Given that similar situation model processes are relevant for both reading a text for comprehension and writing a text, it might be worth exploring to integrate, at least partially, reading comprehension and writing lessons. Irrespective of whether children engage in situation model processing for reading or writing a text, the same skills are learned and practiced. This way, the relevant processes underlying reading and writing can be addressed more efficiently. Such an integrative approach would provide a gladly received response to the growing demand to offer reading and writing instruction not as separate elements and in a less fragmented manner (e.g., Nout, 2015).

Future Directions

The studies described in this thesis suggest several avenues for further research. First, for the intervention studies described in Chapters 2-4, the training materials and lessons were developed in close collaboration with primary school teachers. However, teachers were not involved in the actual training phase. Rather, trained research assistants conducted the trainings using a standardized protocol to

minimize the effects of variables other than the independent variables of interest. It is therefore unknown how the three situation model strategy trainings will work out when they are conducted by teachers in a more naturalistic way or to what extent the trainings are as effective when actually implemented in daily classroom practice. These issues can be investigated in future research.

Second, the strategy trainings have adopted a one-size-fits-all approach, meaning that all children irrespective of their cognitive abilities received the same training in the same way. That is, the trainings did not take into account the fact that for some children the to-be-learned skills might already be better developed. It is yet unknown whether and how the reported strategy trainings can be adjusted in a way to adequately meet the individual demands of children who vary in their level of reading comprehension abilities, reading skills, and reading comprehension strategy use. Future research could explore this in more detail.

Third, the effectiveness of the strategy trainings was only tested immediately after the training phase. Although this is the typical approach in this type of research, it is being increasingly suggested to also evaluate the long-term effects of reading comprehension intervention research (e.g., Snow, 2002). Adopting such a long-term perspective could provide insight into the extent to which the effects of the learned strategies endure.

Fourth, the reading comprehension strategies mental simulation, comprehension monitoring, and inference making were developed and tested as individual trainings. In a sense, this is an artificial distinction given that these three strategies partly overlap. Particularly the skills subservient to inference making and comprehension monitoring are difficult to isolate (McNamara, 2007). It would be interesting for future research to investigate whether it is possible to combine the different strategies within a single training. Importantly, this would require a clear understanding of the unique contributions of each training as well as the extent to which cross-over effects from one reading comprehension strategy to another (e.g., improved inference making due to comprehension monitoring training) are possible.

Fifth, the situation model strategies were taught using direct instruction during multiple training sessions. It would be interesting to also investigate alternative

approaches to stimulate readers to construct a situation model, perhaps ones that requires less effort from teachers. In this regard, one potentially useful approach that has recently been proposed in the field of multimedia learning is to briefly show learners a picture before reading a text (Eitel & Scheiter, 2015) or before each paragraph to help readers to mentally represent the described information (Leopold & Mayer, 2015). The instruction to process the picture before reading a scientific text appears to have a positive influence on the amount of information that is learned from the text (Eitel et al., 2013). The extent to which such an approach is helpful to improve comprehension of narrative texts remains to be investigated. Also, whether inspecting a picture alone before reading is sufficient or whether this needs to be combined with additional instructions or generative activities supporting situation model construction is an issue for further research.

Sixth, the studies reported in this thesis exclusively focused on narrative text. For the reading comprehension intervention studies (Chapter 2-4) this raises the question as to whether the situation model strategy trainings are also effective for other types of text such as expository text. Similarly, for the findings regarding the role of situation models in writing (Chapter 5), one could wonder whether the representational factors "situatedness" and "sensory richness" are as relevant to writing a narrative as to writing other types of text such as a poem or a newspaper article. These issues could be investigated in further research.

Seventh, in Chapter 5 children's ability to construct a situational and sensory rich situation model was related to their creative writing outcome using path analyses. However, the results of this study are only suggestive to the fact that writing processes and outcomes are supported if the situatedness and sensory richness would be stimulated in children. This has not been examined directly, so it is yet unknown whether this actually leads to improved performance. Moreover, this study was restricted to only two representational abilities, so it would be interesting to investigate other factors relevant to situation model construction as well.

Conclusion

Taken together, the results reported in this thesis demonstrate that the situation model framework provides a useful foundation for supporting both reading comprehension and writing in primary school children. By applying situation model

strategies and engaging in processes conducive to situation model construction, children move beyond the text itself and draw upon their imagination to develop an understanding of what the text is about or to produce a text. An important contribution of this thesis is the finding that such a non-linguistic approach to reading can be taught straightforwardly in a relatively short period of time. This could be an interesting starting point to help the current generation of children who increasingly process written textual information (e.g., via social media, email, chats), but nevertheless read a book less often and long, to regain interest in reading books attentively and with comprehension. The research in this thesis hopefully brings this prospect a step closer. In the end, we all aim for a situation where children lose themselves again in a book and enjoy the story as if they were “going to the movie in their head”.

Summary



The research in the present thesis was motivated by alarming findings regarding primary school children's poor reading comprehension performance and declining reading motivation. The main goal of the research in this thesis was to develop and test reading strategy trainings aimed at improving reading comprehension and reading motivation. To ensure that the training sessions were theoretically sound, they were set up within the Situation Model framework. More specifically, we wanted to investigate the influence of situation model construction on reading comprehension and how we can stimulate this construction. Another aim of this thesis was to investigate to what extent situation models play a role in various primary school subjects other than reading comprehension, we particularly looked at whether situation models can perform a function role in producing rather than understanding texts (i.e., writing a narrative). Together, this thesis makes a contribution to translation that is known from basic reading comprehension research to classroom practice at primary school level.

Chapter 1 outlines the theoretical background on reading comprehension from the Situation Model Framework. This chapter presented the main concepts, definitions, and theoretical assumptions. In particular, this chapter elaborates on three cognitive processes important for deep text comprehension on which we developed our differing interventions. Notably, the interventions targeted the situation model strategies of mental simulation, comprehension monitoring, and inference making. The three varying interventions (reported in Chapter 2 to Chapter 4) had a similar design, which enables a direct comparison between the effectiveness of the three situation model focused strategies. The studies employed a pretest-posttest control group design with the dependent variables reading strategy usage, general reading comprehension, and reading motivation. Pre- and posttests consisted of different versions of the same tests. Children from Grades 3 and 4 received training in just one of the three reading comprehension strategies. Each strategy was taught in a 4-week training course containing 8 lessons. The control group followed the school's regular reading comprehension curriculum. Finally, this chapter describes the outline of the empirical chapter within this thesis.

Chapter 2 describes the study investigating the effectiveness of a reading comprehension intervention study aimed at supporting mental simulation skills. Specifically, during the mental simulation training it was tested to observe as to what

extent teaching readers to (1) connect their perceptual, motor, and emotional experiences to text, and (2) mentally stimulate visual and motor information that is implicitly described in a text, facilitates readers situation model construction and hence deep-level comprehension. Effectiveness of the training was evaluated with the sentence-picture verification task and the sentence-sensibility judgment task. The results showed that, compared to the control group, children who had received the mental simulation training showed improved performance on general reading comprehension and scored higher on reading motivation. There were no performance differences between groups on the mental simulation measures. These findings indicate that it is beneficial for children to be encouraged to read and to teach them to connect their sensorimotor experiences to the text they are reading.

Chapter 3 presents an inconsistency-detection intervention aimed at supporting comprehension monitoring strategies to enhance reading comprehension. In particular, the comprehension monitoring training targeted at the updating of the situation model, evaluative and self-regulatory strategies, and metacognitive awareness. Effectiveness of the training was evaluated with the inconsistency-detection task. The results showed that, compared to the control group, fourth graders' inconsistency-detection performance significantly improved after the inconsistency-detection training. Third graders did not show a significant gain, suggesting that this age group may be too young for the presented training. General reading comprehension and reading motivation scores, however, were promising for all children receiving the inconsistency-detection training. These findings indicate that the inconsistency-detection training was effective to enhance children's use of monitoring strategies required for constructing and updating a coherent situation model and to transfer these strategies to novel texts.

Chapter 4 reports on the effectiveness of a reading comprehension intervention study with a focus on inference making. The inference making training aimed at enhancing readers' inference making skills in order to construct a coherent situation model. It addressed the source (text-based versus knowledge-based), type (necessary versus unnecessary for (re-) establishing coherence), and depth of an inference (making single lexical inferences versus combining multiple lexical inferences), as well as the type of searching strategy (forward versus backward). Use of the learned reading comprehension strategy was examined with the probe

recognition task. Results indicated that, compared to a control group, children who followed the experimental training improved their inference making skills to the advantage of situation model construction. Importantly, our training also resulted in increased levels of general reading comprehension and motivation. In sum, this study showed that a 'level of text representation' was valuable and such an approach can provide a useful framework to teach inference making skills to third and fourth graders

In **Chapter 5** we describe a study that focused on exploring the question as to whether the construction of a situation model supports not only the comprehension of, but also the production of a text. This was conducted by asking children to engage in writing a creative narrative and observing their ability to construct a situational and sensory rich situation model. Using path analyses, these representational abilities of children and the narrative descriptions derived from their text were related to the children's creative writing outcome. Results showed that sensory richness and situatedness explained 35% of the variance in creativity scores. Sensory richness influenced the originality/novelty of children's narrative writing directly, whereas situatedness had an indirect influence through the number of sensory words, yet both pathways influenced the outcomes to a comparable extent. Findings suggest that creative writing requires similar representational processes as reading comprehension which may contribute to the development of instructional methods to help children in creative writing assignments.

Chapter 6 proposes a more fundamental perspective at mental simulation of text information during reading. Specifically, it directly explores, within a single study, to what extent different implied visual characteristics of described objects (i.e., shape, color, size and orientation) are mentally simulated during sentence comprehension. Results showed varying match-advantages for shape, size and color; with color showing the strongest effect, but no match-advantage for orientation. Additionally, shape, size and color appeared to be significantly correlated, whereas there were no significant correlations with orientation. These results suggest that the interpretation of match-advantages would benefit from a re-evaluation of the mental simulation account based on a distinction into intrinsic (i.e. shape, size and color) and extrinsic (i.e. orientation) object properties.

Finally, **Chapter 7** provides concluding remarks on the empirical studies described in Chapter 2 through 6 in this thesis. The main findings are discussed from a situation model perspective. Notably, this chapter discusses the obtained findings of three strategies (i.e. mental simulation, comprehension monitoring and inference generating) in light of the aims outlined in the introduction (Chapter 1). Findings from the training studies are discussed according to their contributions to bridging the gap between theory and practice. Moreover, overall recommendations for further research are presented as well as perceived educational implications.

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About the Author

Curriculum Vitae

Publication





Lisanne Thea Bos was born on August 8th, 1988 in Haarlem (The Netherlands). She completed pre-university education at Mendel College, Haarlem (2006). After that, she studied Psychology at the University of Amsterdam (UvA). She obtained a Bachelor in Clinical Child Psychology (2009) and two Masters: School Psychology and Clinical Child Psychology (2011). During this period, she conducted a clinical internship at a school for children with mild learning disabilities (Praktijk Onderwijs Almere) and a combined research and clinical internship at the dyslexia institute IWAL. During and after her Masters, Lisanne worked as junior researcher at the Kohnstamm Institute for the study Pre-COOL. After graduation, she worked part-time as a dyslexia practitioner and whilst in this job Lisanne received the certification of licensed dyslexia practitioner of ONL. In May 2012, she started her PhD research at the department of Educational Neuroscience at the VU University of Amsterdam. The research she conducted during her years as a PhD Candidate is presented in this thesis. In addition, Lisanne acquired teaching experience for several courses of the Bachelor Psychology and Pedagogy, whilst also supervising bachelor- and master-thesis students. Furthermore, she gained organizational experience by acting as a board member of the ICO (Interuniversity Center of Educational Research) educational committee. During this period, she was also the PhD representative chair of the Educational Neuroscience of ICO under the supervision of Prof. Dr. Lydia Krabbendam and Prof. Dr. Paul Kirschner. Moreover, Lisanne also became organizer of the ICO International Fall School 2014 in Blankenbergen (Belgium) and the Reading Network Symposium 2015 in Leiden (The Netherlands). In her spare time Lisanne is an ambassador and coordinator at the VoorleesExpress Amsterdam, a project which promotes the language development of children and enriches the language environment at home. In September 2015, Lisanne started working at Bureau ICE as an account manager/advisor on educational exams and tests (IEP and TOA).

International Peer-Reviewed Publications

- Bos, L. T.**, De Koning, B. B., van Wesel, F., Boonstra, A. M. & Schoot, M. van der (2015). What can Measures of Text Comprehension tell us about Creative Text Production? *Reading and Writing*, 28, 829-849. DOI: 10.1007/s11145-015-9551-6
- Bos, L. T.**, de Koning, B. B., Wassenburg, S. W., & van der Schoot, M. Training Inference Making Skills From a Situation Model Perspective Improves Reading Comprehension.
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- De Koning, B. B., Wassenburg, S. W., **Bos, L. T.**, & van der Schoot, M. (2016). The implied object size is represented during language comprehension. *Discourse Processes* (in press).
- Wassenburg, S. W., **Bos, L. T.**, de Koning, B. B., & van der Schoot, M. (2015). Effects of an Inconsistency-Detection Training Aimed at Improving Comprehension Monitoring in Primary School Children, *Discourse Processes*, 52, 463–488. DOI: 10.1080/0163853X.2015.1025203

Professional Publications

- Bos, L. T.**, Boerma, I. E., Koning, B. B. de & van der Schoot, M. (2013). Maak van lezen een belevenis. *Didaktief*, 1, 56-57.
- Bos, L. T.**, de Koning, B. B. & van der Schoot, M. (2014). Lezen op school of thuis. *Didaktief*, 44(3), 47.

Submitted manuscript

- Bos, L. T.**, de Koning, B. B., & van der Schoot, M. Mental simulations of four visual object properties: Similarities and differences as assessed by the sentence-picture verification task.
- De Koning, B. B., **Bos, L. T.**, Wassenburg, S. W., & van der Schoot, M. Effects of a Reading Strategy Training Aimed at Improving Mental Simulation in Primary School Children.

Organized Conferences & Symposia

- Organizer of the ICO International Fall School: The international networking conference for all PhD candidates in Educational Sciences. Blankenbergen Belgium (November 10 – November 14, 2014).
- Organizer of the Reading Network Symposium. Leiden, The Netherlands (April 10, 2015).

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