The Relation between Reading Strategies and Reading Comprehension

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ABSTRACT
Since 2009, Dutch primary school teachers have started to explicitly teach reading strategies to their students, basing themselves on findings that the use of reading strategies can benefit children's reading comprehension. The aim of the current study was to examine how often Dutch 5th grade students (groep 7) apply reading strategies during reading, and to re-examine the relationship between reading strategies and reading comprehension. The results of this study indicate that children ($N = 116$) frequently paraphrase and activate background knowledge during reading. Activating background knowledge and monitoring were positively related to reading comprehension.

Keywords
Reading comprehension, reading strategies, children

INTRODUCTION

In Dutch education, reading comprehension is an important subject. By teaching children how to understand what they read, teachers provide children with a necessary toolset on which most of formal education is built. Courses such as geography and history require children to study informational texts, and even mathematical problems are frequently presented in story format (Helder, Kraal & Van den Broek, 2015). In order to succeed in Dutch education, children require reading comprehension skills. Unfortunately, 1.5 million people in the Netherlands have reading difficulties, of which many face comprehension difficulties (Stichting Lezen en Schrijven, 2015). Given the importance of reading comprehension skills, educators and researchers have been searching for ways to solve, or at least enlighten reading comprehension difficulties.

In the search of ways to solve comprehension difficulties, researchers have directed their gaze at the strategies that good comprehenders naturally use while reading. The idea behind this was that if good comprehenders use these strategies, they might be beneficial to struggling comprehenders as well. Researchers found that good comprehenders often paraphrase during reading, that is, they rephrase the content of text-elements (Hagaman & Reid, 2013). In addition, good comprehenders form connections between text-elements (Carr, Dewitz, & Patberg 1983), and between their background knowledge and text-elements (Elbro & Buch-Iversen, 2013). Good comprehenders also actively monitor their approach to the texts, so that when they encounter problems in a text, they can shift their approach to create a better representation of the text (Collins, & Smith, 1980).

Given that good comprehenders paraphrase, connect, and monitor, it is possible that when struggling comprehenders are taught to use these strategies during reading, their reading comprehension might improve as well. Following this reasoning, many researchers have set up experimental studies, to find out if reading comprehension indeed improves, when struggling comprehenders apply these reading strategies. Hagaman and Reid (2013) asked children to increasingly paraphrase during reading using the Read Ask Paraphrase Method, and as a result their comprehension improved. Others asked children to fill in blank gaps during reading using their own background knowledge (Elbro & Buch-Iversen, 2013). Their comprehension increased significantly. If children were asked to actively search for contradictions in a text, and thereby had to actively monitor their comprehension of a text, their reading comprehension increased (Collins, & Smith, 1980). These findings indicate a causal connection between reading strategies and reading comprehension.

Teaching reading strategies to struggling comprehenders might thus be a key to improve reading comprehension. Therefore, teachers have started to explicitly teach reading strategies in the hopes of improving the reading comprehension of their students (Moelands et al., 2007). In 2009, explicit teaching of reading strategies was added to the Dutch educational curriculum. Seven years later, it remains unclear, if, and how often Dutch children now apply reading strategies during reading, and how this relates to their reading comprehension.

With regard to the percentage of the time in which Dutch children apply reading strategies during reading, no studies, to the author's knowledge have been performed. In the United States, they did conduct a study, in the late 90s, when the explicit teaching of reading strategies had already attracted attention in the United States (Pearson, 1987). Coté, Goldman, and Saul (1998) analyzed the reading strategies of 4th and 6th grade children while the children read an informative text. The researchers found that on average, children paraphrased 23% of the time, made connections within a text and with background knowledge 31% of the time, and monitored 27% of the time.

Whether these numbers generalize to the Dutch situation remains unclear. To clarify this, and to test the relation between reading strategies and reading comprehension, the aims of the current study were (a) to examine which and how often children apply reading strategies during reading, and (b) to re-examine the relationship between reading strategies and reading comprehension. The main hypothesis was that reading strategies during reading increase reading comprehension. The current study can provide teachers with additional information about the types of reading strategies that they can expect their students to use. In addition, it provides insight into how the use of reading strategies relates to reading comprehension achievement.

METHOD
Study population
A total of 116 5th grade primary school children (Dutch group 7) participated in the current study, of whom 50

(43%) boys. The participants were 11 years old (SD = 5 months), and came from schools in the 'Randstad' area of the Netherlands. Usually a maximum of 10 children was allowed to participate per classroom, to unburden the children's teachers. If more than 10 children signed up to participate, a selection was made. Children with the lowest technical reading ability scores on the CITO (Central Institute of Test Development), that is the scores corresponding to the lowest 20 percent of the country, were excluded first. The current study used quite a lengthy text, of approximately 2,600 words, which took the average reader 20 minutes. Children with low technical reading abilities might need up to 40 minutes to read the same text. This could be experienced as a little more burdensome for some of the children. This is why, if children had to be excluded, children with the lowest CITO technical reading ability scores, were excluded first. If more children needed to be excluded, exclusion was based on an equal representation of reading abilities and gender in the conditions of this study[2]. If a teacher indicated that more than 10 children could participate, no selection was made. In total, 24 out of 140 children (17%) were excluded from participating.

Measurement instruments
Reading Strategies
To measure reading strategies, children were asked to read a text on a computer screen, and when a probe appeared they were asked to tell, in one or two sentences, what they were just thinking prior to the probe. These probes appeared either 8 or 16 times, depending on the conditions that children were assigned to[2]. The text chosen for the current study was about the North Pole (Van Kolfschoten, 2003), and it was especially written for children in grade 5 and 6.

The children's answers were recorded, and coded afterwards. Answers were parsed for information elements. Subsequently the parsed information was coded for paraphrases, within text connections, connections between background knowledge and text elements, and for monitoring. These reading strategies were coded by two independent researchers, using a protocol based on the framework of Coté and colleagues (1998). The intra-class correlation coefficient was .94 (ICC(2,2) = 15.58, p < .01). The outcome variable was calculated by subdividing the total frequency of a particular reading strategy by the total number of parsed information elements.

Reading Comprehension
Reading comprehension was measured by asking children, without a time limit, to retell the text about the North Pole. When participants indicated that they were finished, they were probed twice to retell more. The total number of words that the children retold represented reading comprehension. Retelling a story is considered as a reliable research method to calculate reading comprehension (Afflerbach & Johnston, 1984).

Other Variables
This study also took into account background knowledge and interest. Background knowledge was measured by asking the children to connect 15 content-related keywords to their definitions on a computer screen in 2.5 minutes. The more keywords they connected correctly, the higher their background knowledge. Interest of the topic and text was calculated by asking children how much they enjoyed the topic and the text. The participants could choose between four answers: (1) not at all, (2) a little bit, (3) somewhat, (4) very much.

Procedure
The testing took place in a separate room in the children's primary schools. The children were seated behind a laptop. The testing started with the 2.5-minute background task. After this, they read an informational text and when probes appeared told what they thought just prior to the probe. This task took approximately 20 minutes. The children then retold the story they just read. Afterwards the children answered two multiple-choice questions about their interest in the text and text-topic. After a 5-minute break the procedure repeated itself. In total, the testing took one hour.

Statistical analyses
Single regression analyses per reading strategy were conducted, to test whether the use of the specific reading strategies during reading can predict children's reading comprehension. To control for background influences of the variables: interest, background knowledge, condition, age, test-time on a day, social economic status, and gender, correlation analyses were performed between these background variables and the several reading strategies. When the background variables significantly correlated with reading strategies, these background variables were controlled for in the regression analyses of with the corresponding reading strategies. If a child missed more than one probe, they were excluded from the analyses. Strategies which did not have a normal distribution were transformed with a Van der Waerden transformation. In this case, all the data were ranked from low to high and were assigned to a ranking number, this will contribute to a dataset which will approach a normal distribution (Van der Waerden, 1953, as described in Dijkstra, 1988). f^2 was used as measure of effect size (small: < 0.15; medium: 0.15 – 0.35; large > 0.35). Power was set at .80 for all variables, and the alpha was set at .05.

RESULTS
Correlation analyses
Correlation analyses indicated that paraphrasing was correlated with background knowledge (p < .01, r = -.27) and condition (p = .03, r = .19). Making connections within a text did not correlate with any background variable (p = .10, r = .15). Connecting to background knowledge correlated with condition (p = .04, r = .14) and monitoring correlated with test-time on a day (p = .02, r = .23). For these background variables was controlled in the regression analyses.

[2] The current study was part of a larger study, in which the amount of probes (either 8 or 16 times), and the order of texts (North Pole and Talking – the latter was not included in this study) was manipulated. This led to four different conditions, among which the children were equally subdivided.

Descriptives

One of the 116 (0.9%) participants had three missing values and was excluded from the data. The background characteristics of this participant all fell within the confidence intervals of the background characteristics of the total sample. Therefore, it can be assumed that the participant did not differ from the other participants (Box, Hunter, & Hunter, 1978).

As can be seen in Table 1 the skewness and kurtosis of the variable monitoring did not meet the assumption for normality. The data of this strategy has therefore been transformed with a Van der Waerden transformation. All strategies, except paraphrasing, have outliers,. All outliers were Winsorized to a maximum of three standard deviations.

Table 1
Descriptives of the reading strategies

	M(SD) in %	Skewness; Kurtosis	Outliers
Paraphrase	24.5(15.1)	0.4 ; -0.3	0
Connections			
Within text	20.4(18.5)	0.9 ; 0.3	1
Background knowledge	19.5(15.1)	0.7 ; -0.2	1
Monitoring	0.9(3.2)	4.5 ; 22.6	3

The results of the regression analyses can be found in Table 2. As can be seen here, making connections to background knowledge, and monitoring during reading were positively related to reading comprehension. Making within text connections, and paraphrases during reading

Table 2
Regression analyses between reading strategies and reading comprehension

	ß	p	f^2	1-ß
Paraphrase	-0.10	.32	<.01	.12
Connections				
Within a text	-0.06	.52	<.01	.10
With background knowledge	0.20	.04	.04	
Monitoring	0.22	.04	.05	

Note. The beta of general reading comprehension gives a contrary direction, because 1 stands for strong comprehenders and 5 for struggling comprehenders; which means a positive sign is a negative relation. The beta of specific reading comprehension has a positive relation, as the amount of words retold increases with better comprehension.

did not predict reading comprehension. All effect sizes were small, and all power analyses indicated a power below .80.

CONCLUSION AND DISCUSSION
Reading strategies during reading

The results indicate that Dutch 5th grade children most frequently form connections while reading. Almost 40 percent of the time is spent forming connections, half from which are connections with background knowledge. Children spent approximately a quarter of their time paraphrasing. Monitoring during reading is less prevalent, Dutch children only spent 1% of their reading time monitoring their approach to the text.

These numbers are somewhat different from the numbers of the 1998 Coté, Goldman, and Saul study. Where they found that children spent 31% of the time forming connections during reading, the current study found that this number is

almost 10% higher. Children in their study monitored 27% of the time, far more often than in the current study. Paraphrasing numbers appear to be comparable. The percentages by Coté, et al. (1998) thus do not entirely generalize to the Dutch situation. Given that their study was conducted in the late 90s, it is possible that the differences within the results could be influenced by the shift in reading comprehension instructions, which focuses more explicitly on applying reading strategies, such as forming connections. However, in the United States the shift in instruction already started earlier, so this cannot be said for certain. An alternative explanation to the difference in results, could be methodological. Coté and colleagues asked children to report the content of their thoughts after every sentence they read, while the children in the current study only occasionally reported their thoughts. Asking children to continuously reporting their thoughts could make them more aware of their thoughts (Afflerbach, & Johnston, 1984), and this might trigger more monitoring strategies.

Reading strategies and reading comprehension

The results of the current study indicate that only monitoring and forming connections between background knowledge and text elements positively relate to reading comprehension. A reason why these strategies predict reading comprehension, could be found in the theory of the construct information (CI) model (Van Dijk & Kintsch, 1983). According to this model, there are three levels of reading comprehension. These are surface, text-based, and situation model levels. Each of these levels represents an increasing depth of understanding. Surface level reading comprehension only includes text-elements, without any connections. Text-based reading comprehension includes connections between separate text elements. On the situation model level background knowledge is combined with text-elements. The reading strategy paraphrasing only includes separate text elements, which possibly leads to a surface level comprehension. Forming connections between background knowledge and text elements, is directed at situation model level understanding. This is possibly the reason why forming connections with background knowledge was found to be positively related to children's reading comprehension performance, whereas paraphrasing was not. Based on these results, it seems likely that strategies directed at the situation model level will have a positive relation with reading comprehension.

Monitoring might relate to reading comprehension because children who monitor during reading are more aware of their use of reading strategies. They can then sooner adapt their strategies when they encounter potential reading comprehension difficulties. Successful adaptation prevents reading comprehension difficulties.

Limitations

Some limitations of the current study should be acknowledged. An a priori power analysis indicated that approximately 70 participants would be sufficient to achieve a power of .80, with two predictors, and medium effect sizes. The post hoc power analyses in this study however indicate a low power. It is possible that, because of this, some of the relations between the reading strategies and reading comprehension could not be observed, even though they might have been present. Given the small effect sizes observed in this study, a sample of approximately 250 participants would be required to gain sufficient power. Also, although the experimental setting took place in a

private room of school, sometimes people walked in by accident and background noise could not always be canceled out during the experiment. These disturbances may have influenced the children's achievements. Another limitation lies within the methodology. Even though probing children to report their thoughts is a frequently used way to measure reading strategies, it cannot be said, with absolute certainty, that the thoughts that the children reported, are indeed the thoughts they had just prior to the probe. Because the probe occurred during reading, and not after a break, the likelihood of catching the thought increases (Smallwood & Schooler, 2006). However, it is possible that some of the children made up answers as they went. This may have influenced the results.

Conclusion

This study was the first Dutch study to explore the types of reading strategies that children apply during reading after the shift in explicit strategy instructions in 2009. The results indicate that children form connections most of the time, and that this, in the case of connections between background knowledge and text elements, can predict children's reading comprehension. Earlier studies have indicated that when children are asked to activate background knowledge during reading, their comprehension increased. Given these findings, and the results of the current study, it is possible that stimulating the formation of connections between background knowledge and text elements may benefit children's reading comprehension. However no conclusions about causality can be drawn solely on the basis of the current study.

Reading comprehension is an essential skill, and it is important to keep searching for ways to improve it. With the results of the current study in mind, teachers can expect their students to mostly use reading strategies related to forming connections. This study confirms the positive relation between the formation of background knowledge and reading comprehension, which was described in earlier studies. There therefore might be a possibility that teachers can help students improve comprehension by explicitly teaching them how to form connections between background knowledge and text elements. It is now up to researchers and intervention makers to test whether this theory indeed transforms into practice.

ROLE OF THE STUDENT

Elisa Korthof has been involved in the current study for two consecutive years. She collected part of the data and transcribed the answers that the children gave. In the last year she has been involved as a research assistant, and Bachelor thesis student. In intensive collaboration with her supervisor, Marit Guda, she wrote, and adjusted the coding protocol, searched for relevant information, and served as one of the two main coders. After her supervisor encouraged her to rewrite her thesis into a short paper, she wrote a first draft. She and her supervisor then co-wrote the current version of this paper.

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