The Role of Word Decoding and Language Comprehension in Reading Comprehension

Master thesis

Utrecht University

Master Pedagogical Sciences

Master programme Special Educational Needs

Student: H. C. Weijnman

Student number: 3217558

Supervisor: E. H. de Bree

Second supervisor: E. H. Kroesbergen

Draft 07-06-2013

Preface

This thesis is written to complete my Master Pedagogical Sciences at Utrecht University. In this study I focused on reading comprehension and its underlying mechanisms in children with and without dyslexia. A recommendation in my bachelor thesis was to conduct further research on the basis of reading comprehension. So when I was assigned to a research project regarding children with reading disabilities for my master thesis, I was excited to be able to focus on reading comprehension. It was instructive to obtain the data from children with dyslexia and typical readers. Next to that, it was interesting to perform the analyses on my own collected data.

During the process, there were ups and downs, but I finished my thesis and I am proud of what I have produced. There are some people I want to thank for the help during the process. First of all, my supervisor Elise de Bree for the support and valuable feedback during the writing process. I couldn't have done it without her. Next to that, I want to thank the schools and parents who gave me permission to collect the data. I also would like to thank all the children that I tested. They gave me so much background information and fun during the test sessions. Finally, I would like to thank my family, boyfriend and friends for the moral support during the whole process.

Ineke Weijnman
Sliedrecht, 2013

Abstract

Background - The Simple View of Reading (SVR) aims to give an explanation for performance on reading comprehension. Despite much research on this subject, the underlying mechanisms of reading comprehension are still a matter of debate. Research towards the SVR in children with dyslexia is scarce. This study focuses on the influence of word decoding, language comprehension and phonological awareness on reading comprehension. **Method** – With 102 Dutch participants aged 79 to 134 months in second, third and fourth grade in elementary school, the following tests are conducted at the school: the EMT, Klepel, CELF-4-NL, and FAT. The results on reading comprehension from the standard testing curriculum of the school have been used to measure reading comprehension. **Results** – Results suggest that word decoding influences reading comprehension in children with dyslexia. Language comprehension influences reading comprehension in typical readers. The influence of grade is significant in the relationship between word decoding and reading comprehension in children with dyslexia and between language comprehension and reading comprehension in typical readers. Phonological awareness contributes indirectly to reading comprehension. **Conclusion** –The SVR gives no full answer to mechanisms involved in reading comprehension in children with and without dyslexia. Word decoding seems to be important for reading comprehension at first and when average word decoding has developed language comprehension will become more important. Further research is necessary to get a more complete picture of underlying mechanisms in reading comprehension in children with and without dyslexia. These insights are needed to reduce reading comprehension difficulties.

Keywords: reading comprehension, word decoding, language comprehension, phonological awareness, dyslexia.

Samenvatting

Achtergrond – De Simple View of Reading (SVR) probeert een verklaring te geven voor prestaties op begrijpend lezen. Er is veel onderzoek gedaan naar dit model, maar de exacte samenstelling van onderliggende factoren is niet duidelijk. Daarnaast is er weinig onderzoek gedaan naar de toepassing van dit model bij kinderen met dyslexie. Deze thesis richt zich op de invloed van woord decoderen, taalbegrip en fonologisch bewustzijn op begrijpend lezen. **Methode** – Bij participanten, 102 Nederlandse kinderen tussen de 79 en 134 maanden uit de groepen vier, vijf en zes van reguliere basisscholen, zijn de testen EMT, Klepel, CELF-4-NL, en FAT afgenomen op school. Voor begrijpend lezen is het standaard curriculum van de

school gebruikt. **Resultaten** – Uit de resultaten blijkt dat woord decoderen bij kinderen met dyslexie invloed heeft op begrijpend lezen. Taalbegrip beïnvloedt begrijpend lezen bij kinderen zonder dyslexie. Klas heeft invloed heeft op de relatie tussen woord decoderen en begrijpend lezen bij kinderen met dyslexie en op de relatie tussen taalbegrip en begrijpend lezen bij kinderen zonder dyslexie. Fonologisch bewustzijn beïnvloedt begrijpend lezen indirect. **Conclusie** – De SVR biedt geen volledige verklaring voor de prestaties op begrijpend lezen bij kinderen met en zonder dyslexie. Wanneer woord decoderen nog niet van voldoende niveau is lijkt dit van groter belang voor begrijpend lezen dan taalbegrip, later zal taalbegrip van groter belang zijn voor begrijpend lezen. Vervolgonderzoek is nodig om een completer beeld te krijgen van onderliggende mechanismen van begrijpend lezen bij kinderen met en zonder dyslexie. Deze inzichten zijn nodig om problemen met begrijpend lezen te kunnen verminderen.

Trefwoorden: begrijpend lezen, woord decoderen, taalbegrip, fonologisch bewustzijn, dyslexie.

The Role of Word Decoding and Language Comprehension in Reading Comprehension

There are some skills that are important to make the step from reading a text to summarizing that text. First it is important to be able to decode the words in the text. The second important skill is to recognize the words and word meanings in the text before it can be summarized. Reading comprehension is therefore of great importance. It is suggested that 10% to 15% of elementary school children have reading comprehension difficulties (Yuill & Oakhill, 1991). Research shows that the level of reading comprehension predicts academic achievement (Cain & Oakhill, 2006; Kolic-Vehovec, Bajsanski, & Zubkovic, 2011; Royer, Marchant, Sinatra, & Lovejoy, 1990). Therefore, it is of great importance to understand the underlying skills of reading comprehension. This study will describe underlying factors that are proposed in literature as important for reading comprehension. Furthermore, it will gain more information about the specific role of dyslexia in reading comprehension.

A dominant model that tries to give an answer to the question about the mechanisms involved in reading comprehension is the Simple View of Reading (SVR) (Gough & Tunmer, 1986). In the SVR, reading comprehension is the product of word decoding and language comprehension. There is substantial support for a part of variance in reading comprehension that is explained by the components word decoding and language comprehension, ranging between 33% to 85% of total variance (Adlof, Catts, & Little, 2006; Georgiou, Das, & Hayward, 2009; Johnston & Kirby, 2006; Savage, 2001; Storch & Whithurst, 2002). Word decoding is the process of converting a visual sign into a sound and subsequently synthesize it into words (Hendriksen & Hakvoort, 2010). The role of word decoding in reading comprehension is supported by a study of Wise et al. (2010). They found that word decoding is a strong predictor of reading comprehension in English speaking typical readers in second grade. Language comprehension is the second proposed component of reading comprehension. The SVR (1986) originally proposed listening comprehension instead of language comprehension. Because many recent studies examined language comprehension as predictor and to gain a broader perspective, this study used the aspect of language comprehension. Language comprehension involves understanding the meaning of words and sentences and oral grammar (Hoover & Gough, 1990; Muter, Hulme, Snowling, & Stevenson, 2004). According to the SVR both word decoding and language comprehension have to be average for sufficient reading comprehension (Hoover & Gough, 1990). It is still a matter of debate whether reading comprehension is the result of the sum of word decoding and language comprehension or whether it is the multiplication of the two. This study will not

examine that matter of debate. It needs to be established whether word decoding and language comprehension play a role in reading comprehension in typically developing readers and those with dyslexia.

The relationship between word decoding and reading comprehension seems to decrease over time (Adlof et al., 2006). In first grade formal reading instructions are initiated. It appears that there is an explicit relationship between reading achievement and the quantity of instruction, which is dependent of grade (Adams, 1990; Fitzgerald & Noblit, 2000; Metsala & Ehri, 1998). In the early stages of reading development, decoding is of greater importance compared to reading comprehension. Word decoding takes up that much energy and focus of the limited attention capacity of the reader, rendering reading comprehension secondary (Perfetti & Lesgold, 1977). Children in eighth grade, who have had more reading practice, generally have better decoding skills compared to children in second grade and they are able to pay more attention to the process of reading comprehension (Adlof et al., 2006; Francis, Fletcher, Catts, & Tomblin, 2005; Gough, Hoover, & Petersen, 1996; Chen & Vellutino, 1997). In contrast, in the early stages of reading development, reading comprehension is only accounted for by language comprehension to a limited extent (Tan, Wheldall, Madelaine, & Lee, 2007). In later grades language comprehension becomes the dominant determinant, instead of word decoding (Adlof et al., 2006; Gough et al., 1996). The reading materials in the later grades are more complicated and language comprehension is necessary to master these reading materials (Adlof et al., 2006; Francis et al., 2005). This could mean that the SVR has different outcomes in different grades.

The present study will investigate if word decoding and language comprehension are predictors of reading comprehension and if the level of these predictors change from second to fourth grade. The first research question addressed in this thesis is *To what extent do word decoding and language comprehension predict performance on reading comprehension in typical readers?* The expectation is that word decoding and language comprehension will explain a great amount of variance in reading comprehension. The second research question is divided into two sub questions. *What is the influence of grade on the relationship between word decoding and reading comprehension in typical readers?* and *What is the influence of grade on the relationship between language comprehension and reading comprehension in typical readers?* It is expected that the relationship between word decoding and reading comprehension decreases over time. The relationship between language comprehension and reading comprehension is expected to increase over time.

The SVR model has also been evaluated on the basis of samples of children with learning disorders. Learning disorders affect performances on components involved in the SVR. Therefore, a learning disorder may change the contribution of word decoding and language comprehension to reading comprehension. There are different paths towards reading comprehension difficulties. An example of a path towards poor reading comprehension in the context of language comprehension is specific language impairment (SLI) (Botting, Simkin, & Conti-Ramsden, 2006; Van Weerdenburg, Verhoeven, Van Balkom, & Bosman, 2009). SLI is a primary language disorder which cannot be explained by deficits in other cognitive, neurological, sensory or emotional areas (Leonard, 1998). Due to space limitations children with SLI were not examined in this study. Another path towards poor reading comprehension lies in the context of word decoding, namely the learning disorder dyslexia. Dyslexia is a disorder that is characterized by persistent reading- and orthography difficulties, i.e. difficulties with word decoding. Because word decoding is an important component of reading comprehension, children with dyslexia are an at risk population for reading comprehension difficulties (Lyon, Shaywitz, & Shaywitz, 2003). It appears that children with dyslexia, next to poor word decoding, also have more difficulties in language comprehension compared to children without dyslexia (Joanisse, Manis, Keating, & Seidenberg, 2000). Because children with dyslexia seem to have more difficulties with both of the predictive components in the SVR it is interesting to examine whether the SVR is different for children with dyslexia.

The information that has emerged about word decoding, language comprehension and reading comprehension indicates that there is an interaction between the three components of the SVR. In contrast to the fact that children with dyslexia are an at risk population for reading comprehension difficulties there is research that shows that adults with dyslexia have average reading comprehension (Birch & Chase, 2004; Parrila, Georgiou, & Corkett, 2007). Furthermore, a study of ninety-two English-speaking children aged 7 to 10 shows that children with dyslexia are more able to comprehend what they read compared to poor comprehenders (Nation & Snowling, 1998). However, research on reading comprehension in Dutch children with dyslexia is scarce (Ghesquière & Dewitte, 2006), in contrast to research on children with dyslexia in, for example, the English orthography (Nation & Snowling, 1998; Shankweiler et al., 1999). Cross-linguistic information on dyslexia is useful because each language is different. For example, there are differences in vocabulary and morphology and every language has other phonemes. As a result of these differences the process of

reading is different for each language and each language could have another contribution to word decoding, language comprehension and reading comprehension. Therefore, this study compares the reading comprehension abilities of 75 Dutch children with dyslexia to a control group. The research question is *To what extent do word decoding and language comprehension predict performance on reading comprehension in children with dyslexia?* The expectation is that word decoding and language comprehension will explain some of the variance in reading comprehension. It is also expected that the explained variance of word decoding and language comprehension in reading comprehension is smaller in children with dyslexia compared to typical readers.

The present study will also focus on the influence of grade on the relationships between reading comprehension and word decoding and language comprehension in children with dyslexia. The next research questions are therefore *What is the influence of grade on the relationship between word decoding and reading comprehension in children with dyslexia?* and *What is the influence of grade on the relationship between language comprehension and reading comprehension in children with dyslexia?* Because children with dyslexia have difficulties with word decoding, but are likely to develop average reading comprehension (Birch & Chase, 2004) it is expected that the relationship between word decoding and reading comprehension will decrease over time. It is also expected that the relation between language comprehension and reading comprehension in children with dyslexia increases over time, because children with dyslexia seem to have language comprehension difficulties (Joanisse et al., 2000). Next, it is expected that the influence of grade on the relationship between language comprehension and reading comprehension in children with dyslexia is larger than in typical readers.

Although word decoding and language comprehension can account for a large part of variance in reading comprehension, some of the variance is not explained by word decoding and language comprehension. The SVR model may not yet include all factors that explain reading comprehension. In order to explore those hidden factors, this study will look at additional literature on other cognitive factors that may play a role in reading comprehension. Research shows that phonological awareness is a component that may play a role in reading comprehension. Phonological awareness is the ability to divide words into phonemes and manipulate these phonemes (Bishop & Snowling, 2004). Phonological awareness seems to be a fundamental predictor of word decoding (Bryant, 1995; Compton, 2000; Hulme et al., 2002). It is often named as one of the main problems in children with dyslexia (Vellutino,

Fletcher, Snowling, & Scanlon, 2004). In addition, phonological awareness is also an important component of language comprehension (Cooper, Roth, Speece, & Schatschneider, 2002). There is disagreement among researchers whether phonological awareness contributes directly to reading comprehension (Georgiou et al., 2009; Johnston & Kirby, 2006; Nation and Snowling, 2004) or that it contributes indirectly to reading comprehension through word decoding or language comprehension (Savage & Wolforth, 2007). Therefore, the last main research question in this study is *To what extent is the role of phonological awareness in performance on reading comprehension independent of word decoding and language comprehension?* It is expected that phonological awareness explains a small amount of variance in reading comprehension in both children with dyslexia and typical readers.

Method

Participants

The participants in this research were 118 children with average intelligence in second, third and fourth grade in elementary schools in the Netherlands. Seventy-five children with a mean age of 110 months (SD = 11.5) met the criteria for dyslexia according to the selection criteria of the foundation for dyslexia in the Netherlands (SDN; SDN, 2008). This group included 33 girls (M_{age} = 109.8, SD = 13.9). The other 43 children (M_{age} = 102.1, SD = 9.2) were part of the control group of typical readers. This group included 26 girls (M_{age} = 103.8, SD = 10.3). The children in the control group were randomly selected. This research excluded the participants with missing values. The group of children with technical reading problems finally included 69 children (M_{age} = 110.4, SD = 11.5) with 11 children in second grade, 24 in third grade and 34 in fourth grade. The control group included 33 children (M_{age} = 102.2, SD = 9.5) with 9 children in second grade, 17 in third grade and 7 in fourth grade. Parents were informed about the tests before the test session and permission of the school and parents have been provided. The anonymity of the participants is guaranteed by making all the personal data anonymous.

Instruments

Reading comprehension. The results on reading comprehension on the standard testing curriculum have been used to obtain information about performance on reading comprehension (Gillijns & Verhoeven, 1992). The number of correct answers on a test was converted into a skill score. The skill score is used to answer the questions.

Word Decoding. The Een Minuut Test (EMT) – version B measures technical word reading (Brus & Voeten, 2008). The EMT consists of known words increasing in length and difficulty and has two parallel test cards. Each card has four rows with 116 words which the participant has to read as quickly and accurately as possible in the time span of one minute. In the beginning the words are short (*weg*; road), and increase in length as the test proceeds (*opsieren*; decorate). This task has been reviewed by the COTAN as good (Evers, Braak, Frima, & Van Vliet-Mulder, 2009).

The Klepel – version B (Van den Bos, Lutje Spelberg, Scheepstra, & de Vries, 1994) measures pseudo word reading skills. The Klepel also consists of two parallel test cards with 116 non words for which the participant gets two minutes to read them as quickly and accurately as possible. The words are short and easy at first, like '*kes'*. As the task proceeds the words get longer and more difficult, like '*olseiret'*. The COTAN reviews this test as good and sufficient (Evers et al., 2009). In both the EMT and the Klepel the number of read words (maximum of 116) was converted into a standardized score from 1 up to 19, with a mean of 10 and a standardized score of 19 for the best performance.

Language Comprehension. Subtests from the Clinical Evaluation of Language Fundamentals 4 – Dutch version (CELF-4-NL) are used to measure language comprehension (Kort, Schittekatte, & Compaan, 2010). This study uses a shortened version of the CELF-4 NL, containing four subtests. The subtests *formulating sentences, composing sentences* for the participants of nine years and older and *word structure* for the participants younger than nine years provide an indication of the grammatical development. The subtests *word categories, active vocabulary* for the participants younger than 10 years and *definitions of words* for the participants of 10 years and older provide an indication of the vocabulary knowledge. The number of correct answers per subtest was translated to a standardized score from 1 up to 19, with a mean of 10 and a standardized score of 19 for the best performance. The CELF-4-NL has received a good and sufficient appreciation from the COTAN. However, criterion validity is insufficient (Evers et al., 2009).

Phonological awareness. The Fonemische Analyse Test (FAT) - version A measures the phonemic awareness (Van den Bos, Lutje Spelberg, & De Groot, 2010). The FAT consists of two subtests, Phoneme Omission and Phoneme Exchange. These tests measure the ability to analyze spoken words and to manipulate the phonemes. In the subtest Phoneme Omission, the participant has to figure out what remains of a word when they must leave out a certain part of the spoken word. An example is the word '*boek'* (book). The participant has to say the

word without the ‘k’, so the answer is ‘boe’. In the subtest Phoneme Exchange, the participants get to hear names, consisting of a first name and a surname. The participant has to switch the first phoneme of the first name with the first phoneme of the surname. An example is ‘*Moeder Gans*’ (Mother Goose). The participant has to change these words to ‘*Goeder Mans*’. The score on accuracy is the number of correct answers. The scores run from 0 to 12, with 12 as the highest score. The score on rapidity is the time the participants needed to come to an answer. The score on accuracy and the score on rapidity together were translated to a standardized score from 1 up to 19, with a mean of 10 and a standardized score of 19 for the best performance. The COTAN reviews this test as insufficient (Evers et al., 2009).

Procedure

Elementary schools were contacted throughout the Netherlands. The data collection was spread over the months September 2012 till January 2013. The tests were conducted by 11 researchers from Utrecht University. The researchers were trained prior to testing. For all test sessions, a test manual with a standardized method was followed. The test battery consisted of 12 individual tests, as well as obtaining the results of reading comprehension and mathematics on the standard testing curriculum (Gillijns & Verhoeven, 1992). The individual tests were conducted in quiet areas in a fixed order. Testing included several breaks, rendering sessions of approximately 180 minutes. For this study the results of the EMT (Brus & Voeten, 2008), the Klepel (Van den Bos et al., 1994), the CELF-4NL (Kort et al., 2010) and the FAT version A (Van den Bos et al., 2010) are used. The reading comprehension measure, as part of the standard testing curriculum, was obtained by the classroom teacher.

Data analysis

Before running the analyses the assumptions were verified. All variables were normally distributed in either the group with and without dyslexia. An independent-samples t-test is performed to measure whether the variables are different between children with and without dyslexia. To answer the questions according to the relationships between reading comprehension, word decoding, language comprehension and phonological awareness a Pearson product-moment correlation is performed for every research question. A multiple linear regression analysis is used to answer the questions with respect to predictors of reading comprehension. Finally, a moderator analysis is used to answer the question concerning grade differences across the relationship between word decoding and reading comprehension and the relationship between language comprehension and reading comprehension. Therefore, a

dummy variable of the grades was computed. Also the variables *word decoding* and *language comprehension* were centred.

Results

Representations

The descriptive statistics of participants with and without dyslexia are presented in Table 1. To analyze the results some variables are merged into a composite score. For word decoding this concerns the strongly correlated ($r = 0.873$; $p < .01$) standardized scores of the EMT ($M = 7.2$, $SD = 4.3$) and the Klepel ($M = 7.9$, $SD = 3.9$). For language comprehension the strongly correlated ($r = 0.460$; $p < .01$) standardized scores of the subtests *composing sentences/word structure* ($M = 10.9$, $SD = 2.8$) and *active vocabulary/definitions of words* ($M = 10.5$, $SD = 2.7$) are combined.

Table 1

Descriptive Statistics per Group

Group		Age (months)	Reading Comprehension	Word Decoding[a]	Language Comprehension[a]	Phonological Awareness[a]
Dyslexia	Mean	110.49	22.04	5.36	10.43	7.60
(N=69)	SD	11.56	24.12	2.16	2.32	2.49
	Min.	85.00	-27.00	1.00	6.00	2.60
	Max.	134.00	106.00	11.00	16.00	13.40
Control	Mean	102.18	37.85	12.20	11.26	12.13
(N=33)	SD	9.54	32.71	2.61	2.29	2.75
	Min.	79.00	3.00	8.00	7.00	6.0
	Max.	120.00	112.00	17.00	15.00	17.40

Note. [a] Standardized score

An independent-samples t-test was conducted to compare age, reading comprehension, word decoding, language comprehension and phonological awareness in children with dyslexia and in typical readers. There was a significant difference on reading comprehension between the groups, $t (100)= 2.75$, $p = 0.007$, on word decoding, $t (100)= 13.98$, $p < .001$, and

on phonological awareness, t (100)= 8.32, p < .001. Specifically, the results indicate that children with dyslexia have difficulties with reading comprehension, word decoding and phonological awareness. There was also a significant difference between the groups on age, t (100)= 3.57, p = 0.001. The children with dyslexia were significantly older than the typical readers.

Associations between word decoding, language comprehension, phonological awareness and reading comprehension

Pearson product-moment correlation coefficients were computed to assess the relationships between reading comprehension and word decoding, language comprehension and phonological awareness. The results of these analyses are presented in Table 2.

Table 2

Product-moment Correlations of Students with and without Dyslexia According to Reading Comprehension, Word Decoding, Language Comprehension and Phonological Awareness

Group	Word Decoding	Language Comprehension	Phonological Awareness
Overall (N=102)			
Reading Comprehension	.352*	.353*	.311*
Phonological Awareness	.667*	.518*	
Dyslexia (N=69)			
Reading Comprehension	.261**	.232	.288**
Phonological Awareness	.284**	.538*	
Control (N=33)			
Reading Comprehension	.222	.482*	.055
Phonological Awareness	.399**	.555*	

Note. *p<0.01 **p<0.05

Overall, there were moderate, positive correlations between reading comprehension and word decoding, language comprehension and phonological awareness. Strong, positive correlations were attested between phonological awareness and word decoding and language comprehension. For the group of children with dyslexia the pattern was the same, except that there was no significant correlation between reading comprehension and language

comprehension. Also the significant, positive correlations between reading comprehension and word decoding and between phonological awareness and decoding in children with dyslexia were weak, whereas overall they were moderate and strong. In contrast, for the group of typical readers no significant correlation between reading comprehension and word decoding and between reading comprehension and phonological awareness was found. There were, however, significant, positive, correlations between reading comprehension and language comprehension and between phonological awareness and word decoding and language comprehension.

Predictors of reading comprehension

A multiple linear regression analysis was performed to measure the contribution of word decoding, language comprehension and phonological awareness to reading comprehension in children with and without dyslexia. The results of this analysis are presented in Table 3.

Table 3

Multiple Regression Analysis for Variables Predicting Reading Comprehension

		Model 1		Model 2		Model 3	
		1 predictor		2 predictors		3 predictors	
	Variable	*SE B*	*β*	*SE B*	*β*	*SE B*	*β*
Dyslexia							
(N=69)	Word decoding	1.32	.26**	1.36	.21**	1.37	.19
	Language Comprehension			1.26	.17	1.49	.08
	Phonological Awareness					1.36	.19
	R^2	.068		.096		.122	
	F for change in R^2	4.91**		3.51**		3.01**	
Control							
(N=33)	Word Decoding	2.20	.22	2.30	.02	2.28	.03
	Language Comprehension			2.62	.49**	2.86	.64**
	Phonological Awareness					2.26	.31

R^2	.049	.232	.297
F for change in R^2	1.60	4.54**	4.09**

Note. *p<0.01 **p<0.05

Regression analyses show different outcomes for the two groups. Whereas the model with only word decoding as a predictor of reading comprehension is the best fit for children with dyslexia, the model with word decoding and language comprehension as predictors attributes the most to reading comprehension in typical readers. Word decoding contributes significantly to reading comprehension in readers with dyslexia. Reading comprehension in children with dyslexia is explained by word decoding for 6.8% as can be seen in Table 3. In typical readers language comprehension contributes significantly to reading comprehension. Language comprehension accounts for 18.3% of the variance in reading comprehension in typical readers. It appears that phonological awareness has no significant contribution to reading comprehension in either children with and without dyslexia.

Influence of grade on the relationships between reading comprehension, word decoding and language comprehension

Finally, the relationship between word decoding, language comprehension and reading comprehension in children with and without dyslexia in different grades was analyzed through a moderator analysis with grade as mitigating influence. The results of this analysis are presented in Table 4.

Table 4

Moderator Effect of Grade on the Relationship between Reading Comprehension (RC) and 1) Word Decoding (WD) and 2) Language Comprehension (LC)

		Reading Comprehension				
		B	*SE*	*β*	*F*	R^2
Dyslexia	Grade	.132	4.91	.01		
(N=69)	WD	4.60	1.41	.42*		
	WD*Grade	-3.40	1.74	-.29***	4.08**	.417
	Grade	2.68	4.34	.08		
	LC	2.59	1.38	.26***		

	LC*Grade	-1.46	1.80	-.81	1.22	.059
Control	Grade	-11.62	23.88	-.24		
(N=33)	WD	2.89	3.16	.23		
	WD*Grade	1.53	4.24	.20	.50	.051
	Grade	-1.03	9.27	-.02		
	LC	6.42	2.70	.45**		
	LC*Grade	-.911	4.31	-.05	2.70***	.225

*Note. * p<0.01 ** p*<0.05 *** p*<0.1

There was a negative, significant effect of grade on the relationship between word decoding and reading comprehension in readers with dyslexia. No such effect was found for language comprehension. In contrast, a negative effect of grade on the relationship between language comprehension and reading comprehension was found in the group of typical readers. No such effect was found for word decoding in typical readers.

Discussion

This study focused on word decoding, language comprehension and reading comprehension in children with and without dyslexia. Specifically, the effect of performance on word decoding and language comprehension on the performance of reading comprehension was examined. In addition, the role of phonological awareness as underlying factor of reading comprehension was examined. Knowledge of the underlying skills of reading comprehension is important, because performance on reading comprehension predicts academic achievement (Cain & Oakhill, 2006). In this study children with and without dyslexia differ significantly in performance on word decoding, reading comprehension and phonological awareness. In contrast to previous research, children with dyslexia did not experience more difficulties with language comprehension than typical readers. The chance that this contradiction is the result of the instruments used to measure word decoding and language comprehension is minimized, because they are verified reliable and valid by the COTAN (Evers et al., 2009). Also the influence of intelligence and the effect of region were minimized, because it was made sure that all participants in this study had an average intelligence and came from different schools all over the Netherlands. When interpreting the findings in this study, it is important to take into account that the children with dyslexia were significantly older than the typical readers.

This means that inconsistent results according to children with dyslexia were not caused by a younger age. It is also important to note that there was a strong inter-observer reliability, which means that it is highly unlikely that the results were affected by the fact that the tests were conducted by more than one researcher.

First of all, the relationship between word decoding and reading comprehension in children with and without dyslexia was examined. It was expected that word decoding would predict reading comprehension in both children with and without dyslexia. The findings in this study only partially match that expectation. It appears that word decoding predicts reading comprehension in children with dyslexia, but not in typical readers. An explanation for the fact that word decoding predicts reading comprehension in children with dyslexia is that word decoding difficulties in the early stages of reading development correlate strongly with the level of reading comprehension (Perfetti & Lesgold, 1977). Most participants in this study are in the early stages of reading, which can account for the predictive value that word decoding has in reading comprehension. In contrast with the literature, no significant relationship between word decoding and reading comprehension in typical readers was found in this study. In previous research the research groups consisted of at least 60 children (Adlof et al., 2006; Perfetti & Lesgold, 1977). In this study the research group of typical readers consisted of 33 children. Although the assumptions for a regression analysis were verified, it is possible that the smaller research group led to a different picture. Future researchers should use a larger group of typical readers to make sure that the results will be more reliable. When interpreting the results it should be noted that reading comprehension was now examined by a single measure, namely the standard testing curriculum of the school. Expansion of the testing curriculum with a specific test for reading comprehension might give a better view on the level of reading comprehension. Furthermore, the inclusion of additional instruments might result in a more reliable assessment of reading comprehension.

It was also examined whether grade affects the relationship between word decoding and reading comprehension in readers with and without dyslexia. The findings from children with dyslexia correspond to previous research that stated that the relationship between word decoding and reading comprehension seems to decrease over time (Adlof et al., 2006). This can be related to the fact that children with dyslexia are able to reach average reading comprehension despite their word decoding difficulties **(**Birch & Chase, 2004; Nation & Snowling, 1998; Parrila et al., 2007**)**. In contrast to previous research, there is no significant influence of grade on the relationship between word decoding and reading comprehension in

typical readers. This can be explained by the fact that language comprehension is of great importance to the development of word decoding (Nation & Snowling, 1998, Tunmer, 1989). It is possible that in this study word decoding depends on the level of language comprehension in typical readers and therefore on the relationship between language comprehension and reading comprehension, rendering the relationship between word decoding and reading comprehension insignificant. Another explanation for the inconsistent results in this study is that previous research examined the influence of grade from first to eighth grade. In this study second, third and fourth grade were examined. It is possible that the relationship between word decoding and reading comprehension in typical readers does not change much in only three grades. Therefore, future research should examine the influence of grade in a wider spread of grades.

Third, this study examined the relationship between language comprehension and reading comprehension in children with and without dyslexia. It was expected that language comprehension in both readers with and without dyslexia would predict reading comprehension. The findings in this study partially match this expectation. No effect of language comprehension in reading comprehension was found for the group of children with dyslexia, in contrast to typical readers. An explanation for the difference between children with and without dyslexia is that children with dyslexia have more difficulties with word decoding (Lyon et al., 2003). When no average word decoding has developed, performance on reading comprehension still depends strongly on the level of word decoding (Adlof et al., 2006; Juel, Griffith, & Gough, 1986; Perfetti & Lesgold, 1977). It is possible that in this study the level of language comprehension does not contribute to reading comprehension, because word decoding still strongly affects reading comprehension. This is consistent with the findings that word decoding correlates strongly with reading comprehension in children with dyslexia in this study. It is possible that typical readers already achieved an average level of word decoding. Reading comprehension depends then mainly on the level of language comprehension (Francis et al., 2005; Juel et al., 1986). This may be an explanation for the fact that, despite the small research groups, language comprehension influences reading comprehension in typical readers significantly, in contrast to word decoding.

An influence of grade on the relationship between language comprehension and reading comprehension was not found in children with dyslexia, in contrast to typical readers. The relationship between language comprehension and reading comprehension in typical readers tends to decrease over time. This is in contrast with previous research that stated that

the relationship between language comprehension and reading comprehension would increase over time (Adlof et al., 2006; Gough et al., 1996). This contradiction can be explained by the size of the research groups. The fact that participants were divided into groups with and without dyslexia and into grades made that the group sizes were small, although the assumptions for a moderator analysis were verified. Therefore, future research is recommended to examine the influence of grade with larger research groups to gain more reliable results. When interpreting the results it should be acknowledged that the use of different grades does not represent actual development in word decoding, language comprehension and reading comprehension. In further research it is important to examine whether the influence of grade changes when following the same research groups longitudinally.

Finally, this study examined whether phonological awareness predicts reading comprehension directly or that it contributes indirectly through word decoding and language comprehension (Nation & Snowling, 2004; Savage & Wolforth, 2007). In this study the model with word decoding, language comprehension and phonological awareness as predictors contributes significantly to reading comprehension in children with dyslexia and typical readers. However, no independent influence of phonological awareness in performance on reading comprehension was found in both of the research groups. It can be concluded that phonological awareness contributes indirectly to reading comprehension through word decoding and language comprehension. This can be explained by the fact that phonological awareness seems to be a fundamental predictor of word decoding (Hulme et al., 2002) and an important component of language comprehension (Cooper et al., 2002). Future research might investigate the role of phonological awareness through higher grades. It appears that the relationship between word decoding and phonological awareness decreases over time (Hogan, Catts, & Little, 2005). When the relationship between word decoding and phonological awareness decreases it is possible that there is a more direct contribution of phonological awareness to reading comprehension. When interpreting the findings of this study, it should be noted that the instrument used to measure phonological awareness is reviewed as insufficient. Therefore, it is not clear if this instrument is representative for what it is supposed to measure.

Research to underlying cognitive factors of reading comprehension is important because literature shows evidence for a group of individuals with poor reading comprehension despite having average word decoding and language comprehension (Das, Janzen, &

Georgiou, 2007; Georgiou et al., 2009; Hayward, Das, & Janzen, 2007). These findings raise the idea that, despite phonological awareness, more cognitive factors are involved with reading comprehension. Rapid naming, receptive vocabulary and working memory are suggestions future research might focus on. There is discussion about whether rapid naming and receptive vocabulary are independent components of reading comprehension or that they are just indicators of word decoding and language comprehension. Some researchers name rapid naming as an important underlying skill in word decoding (Vaessen & Blomert, 2010). However, other researchers found in children from elementary school that when rapid naming was added to the SVR model independently of decoding the explained variance in reading comprehension improved significantly (Johnston & Kirby, 2006; Joshi & Aaron, 2000; Wolf & Bowers, 1999). The same is the case with receptive vocabulary. Although some researchers found a direct influence of receptive vocabulary on reading comprehension (Savage, 2006; Tilstra, McMaster, Van den Broek, Kendeou, & Rapp, 2009), receptive vocabulary is often seen as part of language comprehension (Protopapas, Simos, Sideridis, & Mouzaki, 2012; Swanson, Trainin, Necoechea, & Hammil, 2003). On the basis of working memory as a predictor of reading comprehension research concluded that individual differences in working memory indeed predict reading comprehension (Conway et al., 2005; Daneman & Carpenter, 1980; Daneman & Merikle, 1996; Hannon & Daneman, 2001). To understand the group of individuals with poor reading comprehension despite having average word decoding and language comprehension it is important that further research focuses on other possible underlying factors of reading comprehension.

Next to possible underlying factors of reading comprehension, future research might examine the effect of other aspects of technical reading, such as reading fluency, to reading comprehension. Technical reading is one of the aspects of reading skills. Another part of reading skills is spelling, i.e. the transcript of spoken language (Vellutino et al., 2004). Technical reading and spelling seem to influence each other during the stages of language development (Frith, 1985). It also appears that spelling correlates strongly with both word decoding and reading comprehension (Sparks, Patton, Ganschow, Humbach, & Javorsky, 2008). Adding spelling as a contribution to reading comprehension can provide a more complete picture of the relationship between different reading skills related to reading comprehension. Another recommendation for further research is to perform more specific research on the aspects of language comprehension. In that way it is possible to gain more insight in the specific role of grammar and semantics in reading comprehension.

From this study it can be concluded that the SVR model does not give a full answer to the question about mechanisms involved in reading comprehension in children with dyslexia and typical readers. This indicates that more underlying mechanisms are involved in reading comprehension. Phonological awareness contributes indirectly to reading comprehension in both children with and without dyslexia. Word decoding predicts reading comprehension in children with dyslexia and language comprehension predicts reading comprehension in typical readers. That implicates that word decoding is important for reading comprehension when no average word decoding has developed. Later, when word decoding has reached an average level, language comprehension will become more important. The influence of grade was significant according to the relationship between word decoding and reading comprehension in children with dyslexia. Regarding the relationship between language comprehension and reading comprehension the influence of grade was significant in typical readers. The understanding of underlying mechanisms is of great importance for the treatment of reading comprehension difficulties. Although this study adds more knowledge of underlying mechanisms of reading comprehension to the current body of research, it is important that future research focuses on more underlying factors. Therefore, it is important to take the recommendations of the recent study into account.

References

Adams, M. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT.

Adlof, S. M., Catts, H. W., & Little, T. D. (2006). Should the simple view of reading include a fluency component? *Reading and Writing, 19,* 933-958. doi:10.1007/s11145-006-9024-z

Bishop, D., & Snowling, M. (2004). Developmental Dyslexia and SLI Same or different? *Psychological Bulletin, 130,* 858-886. doi:10.1037/0033-2909.130.6.858

Birch, S., & Chase, C. (2004). Visual and language processing deficits in compensated and uncompensated college students with dyslexia. *Journal of Learning Disabilities, 37,* 389–410. doi:10.1177/00222194040370050301

Botting, N., Simkin, Z., & Conti-Ramsden, G. (2006). Associated reading skills in children with a history of specific language impairment (SLI). *Reading and Writing, 19,* 77–98. doi:10.1007/s11145-005-4322-4

Brus, B.T., & Voeten, M.J.M. (2008). *Een-Minuut Test.* Amsterdam: Pearson.

Bryant, P. (1995). Phonological and grammatical skills in learning to read. In: B. De Gelder & J. Morais (Eds.). *Speech and reading. A comparative approach* (pp. 249-266). Hove: Erlbaum Taylor & Francis.

Cain, K., & Oakhill, J. (2006). Profiles of children with specific reading comprehension difficulties. *British Journal of Educational Psychology, 76,* 683–696. doi:10.1348/000709905X67610

Chen, R. S., & Vellutino, F. R. (1997). Prediction of reading ability: A cross-validation study of the simple view of reading. *Journal of Literacy Research, 29,* 1–24. doi:10.1080/10862969709547947

Compton, D. L. (2000). Modeling the response of normally achieving and at-risk first grade children to word reading instruction. *Annals of Dyslexia, 50,* 53-84. doi:10.1007/s11881-000-0017-3

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review, 12,* 769–786. doi:10.3758/BF03196772

Cooper, D. H., Roth, F. P., Speece, D. L., & Schatschneider, C. (2002). The contribution of oral language skills to the development of phonological awareness. *Applied Psycholinguistics, 23,* 399-416. doi:10.1017.S0142716402003053

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19,* 450–466. doi:10.1016/S0022-5371(80)90312-6

Daneman, M., & Merikle, P. M. (1996). Working memory and language comprehension: A meta-analysis. *Psychonomic Bulletin & Review, 3,* 422–433. doi:10.3758/BF03214546

Das, J. P., Janzen, T., & Georgiou, G. (2007). Correlates of Canadian native children's reading performance: From cognitive styles to cognitive processes. *Journal of School Psychology, 45,* 589–602. doi:10.1016/j.jsp.2007.06.004

Evers, A., Braak, M. S. L., Frima, R. M., & Van Vliet-Mulder, J. C. (2009). *COTAN Documentatie.* Amsterdam: Boom test uitgevers.

Fitzgerald, J., & Noblit, G. (2000). Balance in the making: Learning to read in an ethnically diverse first-grade classroom. *Journal of Educational Psychology, 92,* 3-22.

Francis, D. J., Fletcher, J. M., Catts, H., & Tomblin, J. B. (2005). Dimensions affecting the assessment of reading comprehension. In S. G. Paris & S. A. Stahl (Eds.), *Children's reading comprehension and assessment* (pp. 35–49). Mahwah, NJ: Erlbaum.

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. E. Patterson, J. C. Marshall, & M. Coltheart (Eds.), *Surface dyslexia* (pp. 301-330). London: Erlbaum.

Georgiou, G. K., Das, J. P., & Hayward, D. (2009). Revisiting the "simple view of reading" in a group of children with poor reading comprehension. *Journal of Learning Disabilities, 42*, 76-84. doi:10.1177/0022219408326210

Ghesquière, P., & Dewitte, I. (2006). Dyslexie. *Psychopraxis, 8*, 33-36. doi:10.1007/BF03072250

Gillijns, P., & Verhoeven, L. (1992). Het CITO leerlingvolgsysteem: met het oog op de praktijk [The CITO pupil monitoring system: Focus on practice]. *Pedagogische Studiën, 69,* 291–296.

Gough, P. B., Hoover, W. A., & Peterson, C. L. (1996). Some observations on a simple view of reading. In C. Cornoldi & J. Oakhill (Eds.), *Reading comprehension difficulties: Processes and intervention* (pp. 1–14). Mahwah, NJ: Erlbaum.

Gough, P. B., & Tunmer,W. E. (1986). Decoding, reading and reading disability. *Remedial and Special Education, 7*, 6–10. doi:10.1177/074193258600700104

Hannon, B., & Daneman, M. (2001). A new tool for measuring and understanding individual differences in the component processes of reading comprehension. *Journal of Educational Psychology, 93,* 103–128. doi:10.1037/0022-0663.93.1.103

Hayward, D., Das, J. P., & Janzen, T. (2007). Evidence for innovative programs for improvement in reading: Two studies of Canadian children of First Nations. *Journal of Learning Disabilities, 40,* 443–457. doi:10.1177/00222194070400050801

Hendriksen, J. G. M., & Hakvoort, F. J. (2010). Dyslexie. In J. B. M. Bronkhorst et al. (Eds.), *Spraak, Taal en Leren* (p 18-41). Houten: Bohn Stafleu van Loghum. doi:10.1007/978-90-313-7836-4_2

Hogan, T. P., Catts, H. W., & Little, T. D. (2005). The relationship between phonological awareness and reading: Implications for the assessment of phonological awareness. *Language, Speech and Hearing Services in Schools, 36*, 285-293. doi:0161–1461/05/3604–0285

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and writing, 2*, 127-160. doi:10.1007/BF00401799

Hulme, C., Hatcher, P., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology, 82*, 2-28. doi:10.1006/jecp.2002.2670

Joanisse, M. F., Manis, F. R., Keating, P., & Seidenberg, M. S. (2000). Language deficits in dyslexic children: speech perception, phonology, and morphology. *Journal of Experimental Child Psychology, 77*, 30-60. doi:10.1006/jecp.1999.2553

Johnston, T. C., & Kirby, J. R. (2006). The contribution of naming speed to the simple view of reading. *Reading and Writing: An Interdisciplinary Journal, 19*, 339–361. doi:10.1007/s11145-005-4644-2

Joshi, R. M., & Aaron, P. G. (2000). The component model of reading: Simple view of reading made a little more complex. *Reading Psychology, 21*, 85–97. doi:10.1080/02702710050084428

Juel, C., Griffith, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78,* 243-255. doi:243-255 0022-0663/86/$00.75

Kolic-Vehovec, S., Bajsanski, I., & Zubkovic, B. R. (2011). The role of reading strategies in scientific text comprehension and academic achievement of university students. *Review of Psychology, 18*, 81-90.

Kort, W., Schittekatte, M., & Compaan, E. (2010). CELF-4-NL - *Clinical Evaluation of Language Fundamental – Dutch Version.* Amsterdam: Pearson.

Leonard, L. B. (1998). Introduction. In L. B. Leonard (Ed.), *Children with Specific Language Impairment* (pp. 3-8). Massachusetts: MIT Press.

Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). Defining dyslexia, comorbidity, teachers' knowledge of language and reading. A definition of dyslexia. *Annals of Dyslexia, 53,* 1-14. doi:10.1007/s11881-003-0001-9

Metsala, J., & Ehri, L. (1998). *Word recognition in beginning reading*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Muter, V., Hulme, C., Snowling, M. J., & Stevenson, J. (2004). Phonemes, rimes, vocabulary, and grammatical skills as foundations of early reading development: Evidence from a longitudinal study. *Developmental Psychology, 40,* 665– 681. doi:10.1037/0012-1649.40.5.665

Nation, K., & Snowling, M. J. (1998). Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. *Child Development, 69,* 996-1011. doi:10.1111/j.1467-8624.1998.tb06157.x

Nation, K., & Snowling, M. J. (2004). Beyond phonological skills: Broader language skills contribute to the development of reading. *Journal of Research in Reading, 27,* 342–356. doi:10.1111/j.1467-9817.2004.00238.xb

Parrila, R., Georgiou, G., & Corkett, J. (2007). University students with a significant history of reading difficulties: What is and is not compensated? *Exceptionality Education Canada, 17,* 195–220.

Perfetti, C. A., & Lesgold, A. M. (1977). Discourse comprehension and sources of individual differences. In M. A. Just & P. A. Carpenter (Eds.), *Cognitive processes in comprehension* (pp. 141-183). Hillsdale: LEA.

Protopapas, A., Simos, P. G., Sideridis, G. D., & Mouzaki, A. (2012). The components of the simple view of reading: A confirmatory factor analysis. *Reading Psychology, 33*, 217-240. doi:10.1080/02702711.2010.507626

Royer, J. M., Marchant, H. G., Sinatra, G. M., & Lovejoy, D. D. (1990). The prediction of college course performance from reading comprehension performance: Evidence for general and specific prediction factors. *American Educational Research Journal, 27*, 158-179. doi:10.3102/00028312027001158

Savage, R. (2001). The "simple view" of reading: Some evidence and possible implications. *Educational Psychology in Practice, 17,* 17–33. doi:10.1080/02667360120039951

Savage, R. (2006). Reading comprehension is not always the product of nonsense word decoding and linguistic comprehension: Evidence from teenagers who are extremely poor readers. *Scientific Studies of Reading, 10*, 143–164. doi:10.1207/s1532799xssr1002_2

Savage, R., & Wolforth, J. (2007). An additive simple view of reading describes the performance of good and poor readers in higher education. *Exceptionality Education Canada, 17*, 243–268.

Shankweiler, D., Lundquist, E., Katz, L., Stuebing, K. K., Fletcher, J. M., Brady, S., . . . Shaywitz, B. A. (1999). Comprehension and decoding: Patterns of association in children with reading difficulties. *Scientific Studies of Reading, 3*, 69-94. doi:10.1207/s1532799xssr0301_4

Simkin, Z., & Conti-Ramsden, G. (2006). Evidence of reading difficulty in subgroups of children with specific language impairment. *Child Language Teaching and Therapy, 22*, 315–331. doi:10.1191/0265659006ct310xx

Sparks, R. L., Patton, J., Ganschow, L., Humbach, N., & Javorsky, J. (2008). Early first-language reading and spelling skills predict later second-language reading and spelling

skills. *Journal of Educational Psychology, 100,* 162-174. doi:10.1037/0022-0663.100.1.162

Stichting Dyslexie Nederland (SDN, 2008). *Diagnose en behandeling van dyslexie. Brochure van de Stichting Dyslexie Nederland (SDN).* Bilthoven: Stichting Dyslexie Nederland.

Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 38,* 934–947. doi:10.1037/0012-1649.38.6.934

Swanson, L., Trainin, G., Necoechea, D., & Hammil, D. (2003). Rapid naming, phonological awareness, and reading: A meta-analysis of the correlation evidence. *Review of Educational Research, 73,* 407-440. doi:10.3102/00346543073004407

Tan, K. H., Wheldall, K., Madelaine, A., & Lee, L.W. (2007). A review of the simple view of reading: Decoding and linguistic comprehension skills of low-progress readers. *Australian Journal of Learning Disabilities, 12,* 19–30. doi:10.1080/19404150709546827

Tilstra, J., McMaster, K., Van den Broek, P., Kendeou, P., & Rapp, D. (2009). Simple but complex: Components of the simple view of reading across grade levels. *Journal of Research in Reading, 32,* 383-401. doi:10.1111/j.1467-9817.2009.01401.x

Tunmer, W. E. (1989). The role of language-related factors in reading disability. In D. Shankweiler & I. Y. Liberman (Eds.), *Phonology and reading disability: Solving the puzzle* (pp. 91–131). Ann Arbor: University of Michigan Press.

Vaessen, A., & Blomert, L. (2010). Long-term cognitive dynamics of fluent reading development. *Journal of Experimental Child Psychology, 105,* 213-231. doi:10.1016/j.jecp.2009.11.005

Van den Bos, K. P., Lutje Spelberg, H. C., & De Groot, B. J. A. (2010). *Verantwoording en Handleiding van de FAT.* Amsterdam: Pearson.

Van den Bos, K. P., Lutje Spelberg, H. C., Scheepstra, A. J. M., & De Vries, J. (1994). *De Klepel. Vorm A en B. Een test voor de leesvaardigheid van pseudowoorden.* Nijmegen: Berkhout.

Van Weerdenburg, M., Verhoeven, L., Van Balkom, H., & Bosman, A. (2009). Cognitive and linguistic precursors to early literacy achievement in children with specific language impairment. *Scientific Studies of Reading, 13*, 484-507. doi:10.1080/10888430903162936

Vellutino, F. R., Fletcher, J. M., Snowling, M. J. & Scanlon, D. M. (2004). Specific reading disability (dyslexia): what have we learned in the past four decades? *Journal of Child Psychology and Psychiatry, 45, 1*, 2-40. doi:10.1046/j.0021-9630.2003.00305.x

Wise, J. C., Sevcik, R. A., Morris, R. D., Lovett, M. W., Wolf, M., Kuhn, M., . . . Schwanenflugel, P. (2010). The relationship between different measures of oral reading fluency and reading comprehension in second-grade students who evidence different oral reading fluency difficulties. *Language, Speech, and Hearing Services in Schools, 41*, 340-348. doi:10.1044/0161-1461(2009/08-0093

Wolf, M., & Bowers, P. (1999). The "double-deficit hypothesis" for the developmental dyslexias. *Journal of Educational Psychology, 91,* 415–438. doi:10.1037/0022-0663.91.3.415

Yuill, N., & Oakhill, J. (1991). Children's problems in text comprehension: An experimental investigation. New York: Cambridge University Press.