

# Predictors of Reading Literacy in the Netherlands

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## Abstract

The purpose of this study was to construct a longitudinal model that predicts reading literacy at the end of primary school. The data of 822 students who participated on a combined PRIMA and PIRLS 2001 study and PRIMA 2003 study were analyzed. The following student variables were considered for the model predicting Reading Literacy in grade 6: Nonverbal Intelligence, Home Reading Resources, Decoding, Language Comprehension, Mathematics, Reading Motivation, Academic Self-confidence and Reading Literacy in grade 4. The fit of the model was found to be good. The model explained 62% of the variance in Reading Literacy in Grade 6. The three school-learned skills that were entered in the model; Language, Decoding and Mathematics have proven to be important predictors for reading literacy. With respect to the two variables measuring attitudes, Reading Motivation and Academic Self-Confidence, it can be concluded that they contributed, either direct or indirect, to the prediction of reading literacy in grade 6, although they explained only a small part of the variance.

## Introduction

For a student to become a successful and productive adult in society, good reading skills are essential. To refer to the demands for literacy in today's society the term reading literacy was introduced; "the ability to understand and use those written language forms required by society and/or valued by the individual." Reading literacy is now generally accepted as one of the most important skills that children develop. (Mullis, Kennedy, Martin, & Sainsbury, 2006). Reading literacy and the variables that are associated with that ability have been a topic for study for many researchers. The Simple View of Reading states that reading comprehension is a product of two components; decoding and linguistic comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). Decoding is the ability to transform printed letter strings into a phonetic code (Perfetti, 1985). Linguistic comprehension is, according to Gough & Tunmer (1986) "the process by which given lexical (i.e. word) information, sentences and discourses are interpreted". Although many researchers have tried to modify, complicate and refute this theory (Joshi & Aaron, 2000; Adlof, Catts, Little, 2006), there seems to be a consensus that

these components form the basis of reading comprehension abilities. Current models of reading comprehension consider both reading abilities and reading attitudes and motivation as key factors related to reading (Kamil et al., 2000). In this study decoding and language comprehension as well as factors relating to motivation and student background are used as a foundation for constructing a model that predicts reading literacy achievement at the end of primary education in the Netherlands.

Although reading can be seen as a school-learned skill, the differences in reading literacy abilities of students are affected by factors beyond school and teacher variables. The differences already begin at birth. Quantitative genetic studies stated that fifty percent or more of the variance in reading can be attributed to genetic variation (Wagner, R.K., 2005). Various research has shown that intelligence is a predictor that accounts for a significant amount of variance in reading comprehension (Brooks, Fulker & DeFries, 1990; Tiu, Lee, Thompson & Lewis, 2003). Joshi, William & Wood (1998) found that although the components of the simple view of reading, decoding and linguistic comprehension, accounted for most of the variance in reading comprehension (62%), IQ was also a significant predictor. The influence of intelligence seems to be greater in the latter grades than in the earlier grades (Stanovich, Cunningham & Feeman, 1984). This in contrast to decoding skills, which seem to lessen in predictive value in the higher grades.

Reading comprehension and mathematics involve similar cognitive demands, which could explain the relationship that is observed between reading and mathematics in several studies. The influence mathematic skills have on a child's reading literacy ability is demonstrated in a study by Lerkkanen et al., (2005) who found that mathematics and reading comprehension are highly associated and mathematical performance was found to predict reading ability. Lundberg and Sterner (2005) also found a strong relationship between reading achievement and mathematics, they found close to 40% of shared variance between the two variables.

Apart from the child related factors, parents also contribute to the reading abilities of their children through the home literacy environment; reading literacy activities, reading attitudes and motivational factors. Parents are the most important source of information in the first years of a child's life. The parents' interests, beliefs and values form the basis for the child's perceptions. Social interaction is essential for the process of language acquisition (Clark, 2004), children learn from listening, watching and participating in conversations with their family members, but also the immediate environment, such as the peers, and the neighbourhood children live in determines their language development. Snow and Beals (2006) demonstrated that daily conversations that happen in the home provide children with an opportunity for expanding their vocabulary. Children are exposed to new words, explanations and stories that help increase their knowledge about the world. Thus showing

that besides literacy activities, such as reading a book together with your child, or playing word games, even those natural interactions between parent and child that occur during day to day activities can contribute to children's literacy and school success. De Jong & Leseman (2001) examined the impact of preschool home environment for later literacy development in primary school. They found that even after first grade word-decoding ability and reading comprehension were controlled for, home measures remained to have an effect in third grade reading comprehension.

Reading is an activity which benefits from practice and for many children, a great deal of that practice takes place at home. There is a positive and reciprocal relationship between children's reading ability and the time they spent reading. Guthrie & Wigfield (2000) stated that; "as students become engaged readers, they provide themselves with self-generated learning opportunities that are equivalent to several years of education". The amount of reading for enjoyment is primarily determined by motivation. Intrinsic motivation, such as curiosity, involvement and preference for challenge, and to a lesser extent extrinsic motivation, motivational goals and competition, predict the amount of reading (Wigfield & Guthrie, 1997). Cox and Guthrie (2001) found that, when other factors such as ability were controlled for, the amount of reading for enjoyment was predicted most highly by motivation. "Motivation can be seen as an active process in which children construct ideas about language and literacy as they communicate (Verhoeven & Snow, 2001).

The relationship between motivation and reading comprehension could be seen as reciprocal. Children who are motivated to read, read more, which enhances their vocabulary and knowledge of the world, which in turn enhances their reading literacy achievement. With the enhancement of reading achievement, the motivation to read increases, whether the intrinsic or extrinsic motivation, and the circle is complete. This causes a Matthew effect; the gap between good and bad readers increases over time, because the good readers have more exposure to written language (the richer get richer, the poorer get poorer) (Stanovich, 1986; Verhoeven & Vermeer, 2006). This theory was refuted in a study by Aarnoutse et al. (2001) they investigated the differences in the development of decoding-, reading comprehension-, vocabulary- and spelling skills between poor, average and good performers in the Netherlands. They found that the three groups followed similar developmental patterns for all skills, and although the order of the three groups remained the same over grades (the group with the low performers in grade 1, was also the group with the lowest results in grade 6), the differences between the groups lessened for all skills. Thus not confirming the existence of a Matthew effect for reading.

Another factor by which parents influence their children's achievement is academic self-confidence. Parents' positive beliefs and expectations about their children's abilities have

a strong influence on their children's own beliefs about their academic abilities (Meece, Glienke & Burg, 2006). They found that, even after controlling for differences in children's achievement, the parents' perception of the abilities of their children influenced how children perceived their own abilities. Academic self-confidence may have an influence on the skills and abilities of students; previous situations and outcomes provide a basis for expectations, efforts and goals for future situations (Aunola et al., 2002). Students who have positive experiences and belief that they will do well in school, have a different starting point when they are asked to perform a task, then those children who believe they won't be able to perform the task well.

The present study will follow a model proposed by Van Diepen et al. (2007). They computed a series of structural models, with reading literacy predictors measured at the level of the student and at the level of the school. The final integrated model explained 70.5% of the variance in Reading Literacy measured in grade 4 (see Appendix A, figure 1 and Table 1). The fit of this model, was very good (chi-square = 255.32 ( $p = 000$ ), GFI = .975, AGFI = .955, NFI = .960, and RMSEA = .041). The model showed reading literacy to be mediated by reading motivation and word decoding, language, and mathematics. The results also showed six background variables to be significant determinants of fourth-grade reading literacy. Nonverbal intelligence and academic self-confidence were the most important predictors of reading literacy with — to a lesser extent — students' reports of reading at home and the degree to which parents were involved in school activities.

In the present study the research question that will be examined is: Do school-learned skills, intelligence and background factors have a causal relationship with reading literacy at the end of primary school when reading literacy at an earlier grade is entered in the model? Relations between reading literacy and school learned skills, intelligence and background factors measured at the level of the student will be examined. The goal of the study is to construct a longitudinal model of causal relations predicting the reading literacy achievement in grade 6, using the outcomes of various tasks in grade 4. By entering the autoregressive effect of prior reading comprehension results, causal relations can be proven (Wagner, Torgesen & Rashotte, 1994).

In an attempt to further develop the model proposed by Van Diepen et al., and to predict the variation in reading literacy in grade 6 three alterations will be made to the original model: first only student level variables are considered for the model, second a longitudinal model will be created by entering Reading Literacy in grade 6. The following student variables are considered for the model: Nonverbal Intelligence, Home Reading Resources, Decoding, Language Comprehension, Mathematics, Reading Motivation, Academic Self-confidence and Reading Literacy in grade 4.

## Methodology

### *Participants*

The data for this article come from the PRIMA cohort study. The PRIMA Cohort Study is a monitoring study conducted every two years and involves a representative sample of students in elementary education in the Netherlands (Driessen, van Lange & Vierke, 2002). The PRIMA study collects information from schools, teachers, students and parents. A sub-sample of the schools that participated in the PRIMA study in 2001, also took part in an additional study, linking the PRIMA data with PIRLS 2001 data. PIRLS, Progress of International Reading Literacy Study, is an international comparative study that provides data about students' reading achievement and associated factors. A sub-sample of 1483 fourth-grade students of 64 schools participated in the additional study. After students with high levels of missing data were omitted from the database, a total of 1228 students of 62 schools remained for analyses.

In the present study, secondary analyses will be conducted on students enrolled in grade 4 in 2001 and grade 6 in 2003. In order to link the 2001 dataset (with a total of 1228 students) to the 2003 dataset the unique student code was used. Those students with missing data on the reading comprehension test in 2003 were deleted, which resulted in a dataset with 854 students, from 48 schools. Then all the students were deleted from whom the country of origin of the parents was unknown. Deleting 32, leaving 822 students in the dataset for secondary analyses.

### *Instruments*

CITO Reading Comprehension Test: The level of reading literacy ability was assessed with the grade 4 and grade 6 versions of the CITO Reading Comprehension Tests (Staphorsius & Krom, 1998). The tests for both the fourth and the sixth grade consist of three parts with 25 multiple choice questions each. The first module of the test was equal for all students, after which the score on the test determined whether the students took a difficult or an easier module in part two of the testing. Children who answered fewer than 16 questions correct in the first module received the easier part two; the other students answered the more difficult module. The reason for this procedure is that assessment of reading comprehension is more accurate when the students are given a test which difficulty level approaches the ability level of the student (Staphorsius & Krom, 1998). The total number of correct answers was transformed into an achievement score, which ranges between 0 and 100. This makes it possible to compare the scores of the students who took a different second part of the test and who are from different grades.

PRIMA Language test: The test was designed to give an indication of the general proficiency level in Dutch. The test tested three types of linguistic skills: Morphological, Syntactical and Semantic (ITS and SCO-Kohnstamminstituut, 1994a). The students had to evaluate whether each of the 59 sentences in the test are correct or incorrect Cronbach's Alpha .77.

Decoding Test: Decoding skill was assessed using a standardized Dutch word-reading test, the Three Minutes Test (Drie Minuten Toets), Card 3 (Verhoeven, 1995). The students were required to read as many words out loud in one minute. The score was the total number of words read correctly in one minute Cronbach's Alpha .90.

Nonverbal Intelligence Test: Nonverbal Intelligence was measured using two subtests of a nonverbal intelligence test (ITS and SCO-Kohnstamminstituut, 1994b): Composing Figures and Exclusion. Composing Figures involved 19 tasks requiring the child to identify the missing part of a figure out of four alternatives. Exclusion involved 15 tasks requiring the child to identify the deviant figure out of four alternatives. Cronbach's Alpha .77.

CITO Calculation and Mathematics Test: The CITO Calculation and Mathematics Test contain 83 items concerned with numbers, measurement and time (Janssen, Kraemer & Noteboom, 1995). Cronbach's Alpha .89.

PIRLS Student Questionnaire: Each participating student completed a student questionnaire, which included questions about (literacy) activities in and outside of school, students' attitudes towards reading and student characteristics (IEA, 2001).

PRIMA Student Questionnaire: The PRIMA Student Questionnaire included questions about the students' well-being at school (ITS and SCO-Kohnstamminstituut, 2000).

### ***Procedure***

The PRIMA schools who agreed to participate in the additional PIRLS 2001 study were visited by a test administrator, who administered the PIRLS Reading Literacy Test, the PIRLS Student Questionnaire and the Decoding Test. The data was connected with the PRIMA 2001 dataset using a unique student identification number. Those grade 4 students who participated in the 2001 PRIMA and PIRLS combined study (see also Participants) were linked to the PRIMA 2003 dataset using the same identification number.

### ***Selected Predictors***

All selected variables were student level variables collected in grade 4.

#### *PIRLS Student Questionnaire*

Reading Motivation: The scale consisted of eight items (Cronbach's alpha .77). The frequency of; reading for fun outside school; reading stories, novels outside school; borrowing books from the library to read outside school; reading silently in school. Four statements: I only read if I have to (reverse coded), I would be happy if someone gave me a book as a present; I think reading is boring (reverse coded), I enjoy reading.

Home Reading Resources: The scale consisted of three items (Cronbach's alpha .91); Number of books in the home; the presence of a computer and a newspaper in the home.

#### *PRIMA Student Questionnaire*

Academic Self-confidence: The scale consisted of five items (Cronbach's alpha .75). Statements: I perform well; I am one of the best students in the class; most of the children in my class perform better than I do (reverse coded); my teacher thinks I perform well; I don't need a lot of help at school. (Driessen et al., 2002)

## **Results**

### *Descriptives*

In Table 1 the variables that were analyzed, the means and standard deviations are presented. The few missing data that was still in the dataset was dealt with by the substitution of means method. The skewness and kurtosis for all the variables were between the limits of minus two and plus two. The group consisted of 47,9 boys and 52,1% girls.

[Take in Table 1 about here]

### *Structural Model*

To investigate the extend to which reading literacy was predicted by the various variables, analyses were carried out by the use of structural equation modelling, using LISREL (Jöreskog & Sörbom, 1993). The parameters of the model were estimated using a Maximum Likelihood procedure.

The Goodness-of-fit of the proposed model was evaluated with five indicators, according to Hu and Bentlers (1999) criteria's; the ratio of the chi-square value to the degrees of freedom had to be less than 3 to 1.; The Goodness of Fit Index (GFI) > 0.85; Adjusted Goodness of Fit (AGFI) > 0.90; Normed Fit Index (NFI) > 0.90; Root Mean Square Error of Approximation (RMSEA) < 0.08.

The structural model was created with Intelligence and Home Reading Resources as

background variables. Decoding, Language, Mathematics, Motivation, and Academic Self-confidence were entered as intermediate variables. Reading Literacy grade 4 was entered as criterion variable and acted as an auto-regressor for predicting Reading Literacy in grade 6, the second criterion variable.

Those parameters significant at a level of .01 are marked with two asterisks, those at a level of .05 with one asterisk.

The correlations between the predictor- and criterion variables are presented in table 2. All of the correlations are positive and are ranged from low to high. As anticipated Reading Literacy results in both grade 4 and grade 6 are found to have a significant relation with all the variables that will be entered in the model. Naturally the relation between Reading Literacy in grade 4 and Reading Literacy in grade 6 is the strongest relation. Also the relations with Language and Mathematics are very strong. There are positive relations between all the predictor variables as well.

[Take in Table 2 about here]

As can be seen in Figure 1 a structural model was constructed for all students entering all background and intermediate variables in the model (the standardized regression weights are presented in the model). The fit of the model was good (Chi-square= 25,63, df= 8, p=.00, GFI= 0.99, AGFI= 0.96, NFI = 0.99, RMSEA= 0.051). The model explained 62% of the variance in Reading Literacy in Grade 6. The standardized regression weights and unexplained variance for all the intermediate variables can be found in Appendix B.

[Take in Figure 1 about here]

[Take in Table 3 about here]

As expected the best predictor for Reading Literacy in Grade 6 is Reading Literacy in Grade 4. Also Language and Mathematics are powerful predictors for explaining the variance in Reading Literacy at the end of primary school. A number of other predictors entered in the model were found to be significant as well, though sometimes explaining only a small amount of the variance.

The background variables that were entered in the model related to a number of the variables. Nonverbal Intelligence was found to predict the intermediate variables of Language, Mathematics and Academic Self-Confidence, but not Decoding or Reading Motivation. There was also a significant relation between Intelligence and Reading Comprehension in Grade 4, but there was no direct relation between Intelligence and Reading Literacy in Grade 6.

Home Reading Resources contributed significantly to the prediction of some of the intermediate variables, although not as much as Intelligence. There was a direct relationship between Home Reading Resources and Reading Comprehension in Grade 4, and also in Grade 6, though the regression coefficients were small, they were significant. Home Reading Resources was also found to predict Language and Reading Motivation. Thus students who live in a home with more books, a newspaper and a computer have better language skills and are more motivated than children who have fewer resources available in their homes.

Language is for both grade 4 and grade 6 a powerful predictor of reading literacy. As can be seen in Table 3, the predictive value for grade 4 seems to be much larger (.40) than the predictive value for grade 6 (.20). Though the standardized total effects (Table 3) show that the observed decline in predictive power for Language between grade 4 and grade 6 can be accounted for by the connection between Language and the other intermediate variables in the model. The standardized total effects are the combined effects of the direct relation between the intermediate variable and the criterion variable plus the indirect effects the intermediate variable contributes to the model by the connection with the other intermediate variables. Thus Language is found to be a powerful variable for prediction reading literacy, either direct or indirect.

Out of the three school-learned skills, Decoding explained the least of the variance in reading literacy. Students who have good decoding skills in grade 4, show better reading comprehension skills in grade 6, but the explained variance of reading literacy is small. There is a strong causal relation between Mathematic Skills and Reading Literacy.

Reading motivation and Academic Self-Confidence were related to reading comprehension in grade 6, although the regression coefficients were very small. Children who are highly motivated to read in grade 4 and who have the confidence that they will do well in school, seem to show better reading literacy abilities in grade 6.

## **Conclusion and Implications**

Our aim of this study was to create a longitudinal model predicting reading literacy at the end of primary school in the Netherlands. The predictive power that school-learned skills, intelligence and background factors have on reading literacy was examined. The results show that the variable with the most predictive power for Reading Literacy in grade 6 was Reading Literacy in grade 4. The best predictor of present or future behaviour often is past behaviour. The hypothesized causal relations that could be proven by entering the auto-regressive effect of reading literacy in grade 4 in the model predicting Reading Literacy in grade 6 are found for

several of the predictors (Wagner, Torgesen & Rashotte, 1994).

The fit of the model was found to be good. The model explained 62% of the variance in Reading Literacy in Grade 6. Language and Decoding, the two components that are according to the Simple View of Reading the building blocks for reading abilities are proven to be important predictors for reading literacy (Gough & Tunmer, 1986; Hoover & Gough, 1990). Also the third school learned skill, Mathematics, was found to have predictive value in the model.

Decoding was expected to have no or only little predictive value on the reading comprehension skills in grade 6. But the results show decoding was still a significant, predictor of reading comprehension in grade 6. Thus students who have good decoding skills in grade 4, show better reading comprehension skills in grade 6. The educational field could learn from this finding that decoding is a skill that should be practised even in the higher grades, so students are able to apply their decoding skills more routinely and accurately. Thus making it easier to read the more complicated texts that students are exposed to in the higher grades.

Language was found to explain a great amount of the variance in Reading Literacy in grade 6, even when reading literacy in an earlier grade was entered in the model. This relationship was to be expected according to the Simple View of Reading. The remark has to be made that linguistic comprehension as stated in the Simple View of Reading is generally tested by a listening comprehension task, where we used a test that tested three types of linguistic skills: Morphological, Syntactical and Semantic.

Nonverbal Intelligence, which was entered in the model as a background variable, was found to relate to several of the school-learned skills and attitude variables and was directly related to reading literacy in grade 4. Nonverbal Intelligence seems to be an important direct and indirect predictor for Reading Literacy. The predictive power of the second background variable, Home Reading Resources, was found to be small.

With respect to the two variables measuring attitudes, Reading Motivation and Academic Self-Confidence, it can be concluded that they contributed significantly to the prediction of reading literacy in grade 6, although the regression coefficients that were found were very small. The results show that students who have a positive reading attitude in grade 4 and who have high self-confidence show better reading literacy abilities in grade 6.

A limitation of this study is that other background variables and language/reading abilities not

focused upon in this study are also likely to have an influence on reading literacy performance. The predictive battery could have included, for example, listening comprehension and vocabulary. Also home background variables such as early childhood reading activities and family characteristics, for instance socioeconomic status should be entered in the model.

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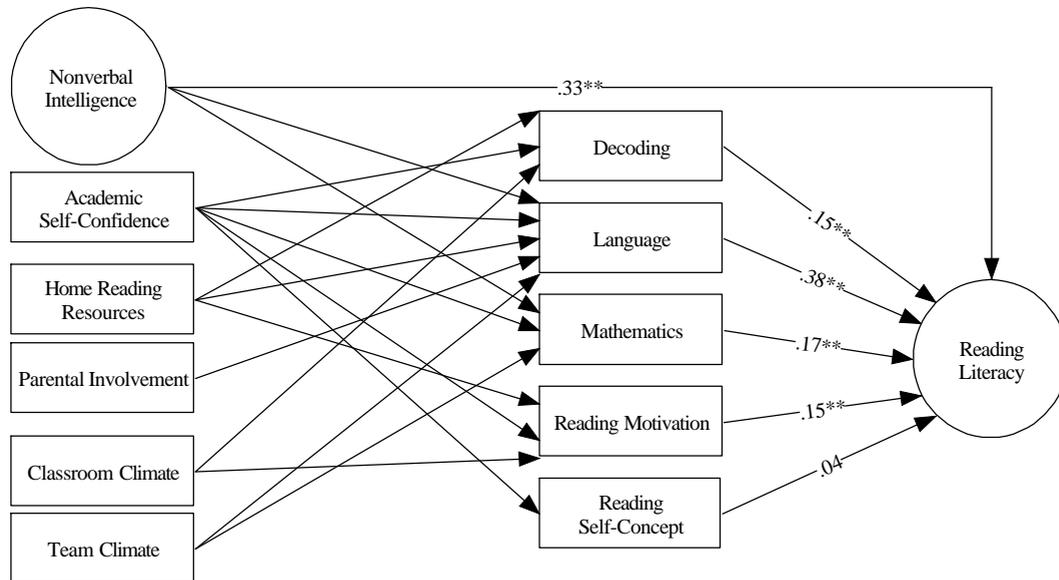
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**Appendix A: Prediction of Reading Literacy as proposed by Van Diepen et al., 2007**

*Fig.A1: Integrated model for the prediction of Reading Literacy*



*Table A1: Standardized Regression Weights for Relations between Background and Intermediate Variables in Figure 1*

	Decoding	Language	Mathematics	Reading Motivation	Reading Self- Concept
Nonverbal Intelligence		$.35^{**}$	$.55^{**}$		
Self-Confidence	$.19^{**}$	$.11^{**}$	$.30^{**}$	$.09^{**}$	$.25^{**}$
Home Reading Resources	$.10^{**}$	$.07^*$		$.13^{**}$	
Parental Involvement		$.09^{**}$			
Classroom Climate	$.05^*$			$.08^{**}$	
Team Climate		$.08^{**}$	$.07^{**}$		

## Appendix B: Standardized regression weights and unexplained variance

Table B1: Standardized regression weights for all students

	Reading Literacy Grade 4	Reading Literacy Grade 6	Decoding	Language	Mathematics	Reading Motivation	Academic Self-confidence
Nonverbal Intelligence	<b>.16**</b>	.05	-	<b>.26**</b>	<b>.43**</b>	-	<b>.19**</b>
Home Reading Resources	<b>.07**</b>	<b>.06**</b>	-	<b>.11**</b>	-	<b>.10**</b>	-

	Reading Literacy Grade 4	Decoding	Language	Mathematics	Reading Motivation	Academic Self-confidence
Reading Literacy Grade 4	-	<b>.12**</b>	<b>.40**</b>	<b>.20**</b>	<b>.14**</b>	.03
Reading Literacy Grade 6	<b>.42**</b>	<b>.08**</b>	<b>.20**</b>	<b>.15**</b>	<b>.07**</b>	<b>.07**</b>

Table B2: Unexplained variance all students

Reading Literacy Grade 4	Reading Literacy Grade 6	Decoding	Language	Mathematics	Reading Motivation	Academic Self-confidence
.48	.38	1.00	.91	.81	.99	.96