Aliteracy : causes and solutions

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Chapter 1

General Introduction

Successful people often describe themselves as avid readers thereby suggesting that reading strongly attributes to their successes. The writer Maarten 't Hart, for instance, enjoyed recreational reading from first grade on. He finished all books he brought home from his weekly visit to the local library in just a few days ('t Hart, 2015). Stephen King wrote in his book 'On Writing: A Memoir of the Craft': "If you don't have time to read, you don't have the time (or the tools) to write. Simple as that." (2000, p. 147). Former US president John F. Kennedy was a speed reader who could read about 2,500 words per minute (10 times the average reading speed) and not only read six newspapers from cover to cover during breakfast, but enjoyed reading biographies and James Bond novels as well (Meagher & Gragg, 2011).

A wonderful example of the benefit of recreational reading is the distribution of the Armed Services Editions (ASEs), 123 million pocket-sized paperbacks, among American soldiers during World War II. In a fascinating account of this project, Manning (2014) described the impact this program had on young American soldiers sent to war more than 70 years ago. The books, started as an initiative by librarians and later taken over by the US Council on Books in Wartime, were extremely popular among soldiers and had a great impact on them both during and after the war. During the war, the books helped soldiers to abide waiting periods at the front and to distract wounded soldiers from their injuries. Shortly before D-day, a million books were spread among the American soldiers to keep morale high while awaiting the invasion. In other words, the books provided an occasional 'escape from hell'. Besides the impact of the ASEs during the war, many soldiers maintained the reading habits they developed in wartime after their return. The GI Bill of Rights - a law that provided a range of benefits for returning World War II veterans - provided former soldiers with cash payments of tuition and living expenses to attend university, high school or vocational education. This policy was criticized because educators feared that the former soldiers would not be able to meet educational standards. The opposite was true: the soldiers had developed reading habits and were well informed on many topics by reading the ASEs during the war. Students at the University of California referred to the former soldiers as DARs: 'Damned Average Raisers' because they had excellent study skills and outperformed most of their fellow students.

Reading for pleasure makes a difference

Apart from anecdotal support for the importance of recreational reading, there are studies revealing evidence for effects of recreational reading on academic and professional success. In a study including approximately 3,500 Dutch adults, the

Dutch sociologist Notten (2011) analyzed retrospective reports of parental practices for children between 5 and 15 years. It turned out that higher educational attainments were related to more parental reading guidance, including book recommendations from parents, parent-student discussions about books, and parental interest in what their son or daughter is reading. Longitudinal research that assessed the reading activities and skills of the same participants at various points in time to produce more convincing evidence for causal relations also supports Notten's model. For instance, a study by Gottfried, Schlackman, Gottfried, and Boutin-Martinez (2015) showed that reading in preschool age is predictive for reading motivation in adolescence while reading motivation in adolescence predicts higher educational attainment at age 29. Another longitudinal study also supports the hypothesis that reading for pleasure is vital for later professional success. Taylor (2013), a sociologist from the UK, analyzed 17,200 questionnaires completed by people born in 1970. He assessed recreational activities at the age of 16 and their professional status at the age of 33. After controlling for educational attainment, recreational reading appeared to be the only out-of-school activity of 16-year-olds that links to better career perspectives. Individuals who reported reading books at least once a month at age 16 were more likely to have managerial or professional jobs at age 33 as compared to those who did not read books. No other out-of-school activities, including playing an instrument, theatre attendance or sports, made a difference for career prospects.

The EU High Level Group of Experts on Literacy (2012) argued that in the near future literacy skills will become increasingly important for professional success. As about 30% of semi- and unskilled jobs will disappear between 2010 and 2020, low literacy may not only be problematic for the individual's academic and professional success, but also for prosperity and wellbeing in society at large. The Dutch opinion maker H. J. A. Hofland argued that a new functional illiterate underclass (individuals whose reading skills are insufficient to fully participate in present day society) might enlarge the risk of political instability of society due to insufficiently informed citizens and over-simplified opinions (Hofland, June 3, 2015). In their final report the EU High Level Group of Experts on Literacy (2012) concluded that currently about 20% of adult Europeans miss the literacy skills to find a job, adequately support their children's literacy, manage their own health, and take advantage of digital development.

Reading: a boost for academic as well as social skills

"With less print exposure, low ability readers are unlikely to improve their reading and spelling skills to the same extent as their peers who do choose to read" (Mol & Bus,

2011, p. 289). Moreover, a low level of reading proficiency has serious consequences for individual students' other academic skills and opportunities to expand those. Reading is not only an important academic skill in itself, but reading is an important tool for learning other academic skills (reading-to-learn). Even learning mathematics is strongly related to reading skills (e.g., Jordan, 2007).

Reading is also important for the development of social skills that are indispensable for professional success. The Dutch writer Philip Huff suggested in De Correspondent (July 13, 2015) that recreational reading also contributes to understanding life events. Readers are more successful in social situations including collegial contacts and job interviews. Reading allows them to be better able to see the world from other peoples' point of view. Preschoolers, for instance, score higher on social abilities as assessed by a Theory of Mind (ToM) test when their parents read more fictional narratives from storybooks to them (Mar, Tackett, & Moore, 2010). That is, they are better able to take another person's perspective and respond in an empathic way to other people. Likewise, in a series of experiments focusing on adults, Kidd and Castano (2013) found that reading literary fiction temporarily enhances the complex social skill of "mind-reading" to understand others' mental states. The study shows that it is not just any fiction that is effective in fostering ToM, but rather that the literary quality of the fiction is the determining factor. Literary fiction (Anton Chekhov or Alice Munro) is preferable to popular fiction (Dan Brown or Ian Fleming).

Main issues in the current thesis

Although recreational reading seems vital for reading skill development, a substantial portion of students stop reading recreationally early in their development as a reader (Mol & Bus, 2011). It is a striking finding that many Dutch adolescents do not spend any time on recreational reading. Almost half of the Dutch adolescents (49%) report that they never or almost never read for pleasure in their leisure time. Compared to other countries, this percentage is rather high in the Netherlands. Only 2 out of 65 countries participating in the PISA study have a higher percentage of students reporting that they do not read (OECD, 2010a). Probably as a result of this, rankings of Dutch students in international studies are decreasing (Kordes, Bolsinova, Limpens, & Stolwijk, 2013; Meelissen et al., 2012). In the PIRLS study, for instance, the Netherlands ranked 2nd in 2001, 9th in 2006, and 13th in 2011. In other words, Dutch students are slowly falling behind probably as a result of declining interest in recreational reading and, hence, lack of reading practice already in primary school.

Many students thus face 'aliteracy' (Boorstin, 1984), that is, they have the ability to read but do not practice reading and, due to lack of practice, their reading skills remain underdeveloped. In 2007, the Dutch Inspectorate of Education reported that 25% of students were at least two years behind in reading skill when they leave primary school. Lack of practice may also explain why the number of adolescents and adults facing serious delays in reading skill is much larger than the 4% diagnosed as dyslexic (Blomert, 2006). A substantial minority (14.4%) of Dutch adolescents scored below level 2 in the most recent PISA study, which indicates that they are functionally illiterate (OECD, 2010b). In all, there are about 1,3 million people in the Netherlands over the age of 16 years who experience problems with reading and writing (Buisman, Allen, Fouarge, Houtkoop, & van der Velden, 2013).

This thesis focuses on two main issues related to aliteracy:

1. Why so many students have already stopped reading in the latter years of primary school, and
2. how students can be supported to be more motivated to read, to read recreationally in their leisure time and to become more proficient readers.

Overview of the dissertation

Chapter 2 includes results of a large-scale longitudinal study focusing on the development of reading motivation in primary school. Changes in reading motivation in two phases, from grade 3 to grade 4 and from grade 5 to grade 6, are described in relation to reading proficiency, gender, appreciation of the school library, and parental support of book reading at home.

Chapter 3 examines whether, due to negative reading experiences, students develop negative emotions about reading and perceive reading as a source of threat. That is, students build up negative connotations with reading that may become a reason to avoid reading, just as individuals with some anxiety disorder avoid the source of threat (e.g., Beidel & Alfana, 2011; Kase & Ledley, 2007; Kerig & Wenar, 2006). Perceiving reading as threatening may strengthen a causal spiral of disinterest and decreasing time spent reading. Neurobiological studies show, for instance, that anxious people have difficulty with the use of attentional control mechanisms during tasks that are related to their anxiety (Bishop, 2009; Eysenck & Derakshan, 2011; Frewen, Dozois, Joanisse, & Neufeld, 2008).

The EU High Level Group of Experts on Literacy (2012) recommended, amongst other things, the creation of a literate environment with a large selection of reading materials. Thus **Chapter 4** investigates whether an enriched school library including a

large and modern book collection can improve interest in reading and literacy skills.

Chapter 5 describes an experiment that addresses the potential of digital reading including a Pedagogical Agent. Even though most schools do schedule time to read self-selected hardcopy print books, this is usually limited to one or two hours a week and there is no guidance when students read for pleasure. After the heavy investment in early reading instruction, literacy development is neglected in late primary school (Snow & Moje, 2010). The need to develop a reading routine and make reading miles is left to a student's own responsibility as soon as they are able to read independently. Prolonged guidance of reading may be vital to make students continue reading practice. The impact of digital support in the form of a pedagogical agent (PA) providing guidance during reading is explored in line with Kirschner, Sweller and Clark's (2006) argument for the use of guided instruction instead of unguided or minimally guided instruction.

Finally, **Chapter 6** reviews the conclusions of the studies presented in this thesis, implications for future research and recommendations to help students become, or remain, enthusiastic readers.

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Chapter 2

Development of reading motivation in primary school

Abstract

Interest in reading is important for the development of reading skill and for academic and professional success. In this cross-sectional, longitudinal study in 85 Dutch primary schools, we examined how stable students' motivation for reading is after the stage of beginning reading instruction. Students were followed from grade 3 to grade 4 (N = 1382) and from grade 5 to grade 6 (N = 1474). Multilevel regression analyses were applied to test whether gender, reading ability, the student's opinion about the school library and adult support influenced reading motivation. Main results were: (1) reading motivation declined in the higher grades of primary school, especially in groups with low and average reading ability, and (2) the quality of the school library is related to the decline of motivation even after controlling for home characteristics.

Based on:

Nielen, T. M. J., & Bus, A. G. (2013). Ontwikkeling van de leesattitude op de basisschool en de rol van sekse, leesniveau, de leescultuur thuis en kenmerken van de schoolbibliotheek. [Development of reading motivation in primary school and the role of gender, reading skill, home literacy environment and school library characteristics]. In D. Schram (Ed.), *De aarzelende lezer over de streep: recente wetenschappelijke inzichten [Winning over reluctant readers: recent scientific insights]* (pp. 207-226). Delft, Nederland: Eburon.

Jeanne Chall (1983) was the first to describe the 'fourth-grade slump', a decline in reading skill development that starts in grade 4. We hypothesize that there is a decline in reading motivation as well. In particular, when students find it hard to read independently and comprehend text, there is a decline in reading motivation (e.g., Becker, McElvany, & Kortenbruck, 2010; Mol & Bus, 2011; Morgan & Fuchs, 2007). We therefore expect to find a decline in reading motivation as well as correlations between reading skills and reading motivation (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Pressley, 2006). The literature provides evidence showing that girls in primary school (grades 3 to 6; McGeown, Goodwin, Henderson, & Wright, 2012; Wigfield & Guthrie, 1997), adolescence (OECD, 2010) and adulthood (Miesen, 2006) are more motivated to read than boys. We expected that girls show more interest in reading than boys and may therefore show less decline in motivation in the higher grades of primary education. There is indeed evidence that grade 4 and 5 girls are more confident about their reading skills than boys (Eccles et al., 1993) and read more than boys (Anderson, Wilson, & Fielding, 1988). Girls in secondary school also read more often than boys (Stokmans, 2006).

We were especially interested in the quality of books in the child's environment as a relevant environmental factor that may influence students' reading motivation. According to Krashen (2011), access to a large collection of interesting books is paramount for the reading development of students. If students can easily find interesting reading materials, they will become more enthusiastic readers, read more and their reading performance will increase. In line with this theory, many studies have shown the positive effects of well-equipped school libraries on reading achievement (e.g., Francis, Lance, & Lietzau, 2010; Scholastic, 2008). This study was carried out in schools with a more or less improved library. Some schools had started to improve their library while other schools had the intention to improve the school library in the short term but had not yet begun. It was expected that an attractive book collection in the school library may affect students' interest in reading. Testing was therefore conducted to determine if reading motivation is influenced by whether students consider the book collection in the school library as attractive.

Testing the role of the school library, we controlled for characteristics of the home environment that seem to explain students' interest in reading. When parents model reading behavior in their leisure time, children seem to be more enthusiastic and better readers (Bråten, Lie, Andreassen, & Olaussen, 1999; Mol & Bus, 2011). There is also evidence that parents can stimulate the child's enthusiasm for reading by discussing the books that their child reads (Baker, 2003). Experimental evidence for

the importance of adult support at home comes from studies that address the summer reading gap (Kim & White, 2008, 2011). We assessed whether parents discuss books with their child as an indicator of stimulating homes.

Method

Design

Questionnaires were administered in 87 schools in grades 3 and 5 in November and December 2010 and a year later in grades 4 and 6 to the same students. A cross-sectional and longitudinal design were combined. In the first phase, students in grades 3 and 5 participated and a year later the same students participated in grades 4 and 6.

Participants

In this study participated students from 87 primary schools from all over the country, including schools for special education, schools with a religious foundation, Montessori schools and public schools. The number of participants per classroom varied probably due to the teachers' willingness to invest in the study. Students were only included in the data analyses (N = 2,856) if they had completed the questionnaires at both time points (grade 3 and 4 or grade 5 and 6). Participants were excluded if they had filled in the questionnaire at a single time point (N = 1248) or did not finish the questionnaire at one of the time points (N = 195).

Measurement instruments

Reading motivation. The reading attitude scale of Aarnoutse (1990) was used to measure reading motivation. The questionnaire contains 27 dichotomous (yes/no) items such as: 'Do you like reading?' and 'Do you only read at school because you have to?' Reliability of the scale was satisfactory (α = .92). A higher score indicates more interest in reading.

Time and cohort. Based on the group characteristics we have created two variables: a variable time that indicates the time of measurement (grades 3/5 versus grades 4/6), and cohort that indicates which age group (grades 3/4 versus grades 5/6).

Reading skill. Reading skill was measured through a single question: 'How good is your reading skill?' (not very good/average/very good). This is a reasonable indicator for reading skill because students in this age group are quite capable of distinguishing their reading skill from their motivation to read and can report their skill level reasonably accurately (Eccles et al., 1993).

School library. Students were asked to evaluate the library at school choosing from three options: 'We do not have a school library' / 'I do not like to go there' / 'I like to go there'. We recoded the data by combining the first two options as an indication of the lack of an attractive library in the student's opinion.

Parental reading behavior. Students were asked how often their father or mother reads a book (never/sometimes/often). This question provides an indication for the extent to which parents model reading to the child.

Discuss books with parents. To gain insight in the interest that parents show in their child's reading students were asked: 'How often do you talk with your mother or father about books?' (never/sometimes/often).

Procedure

The data was collected by a commercial institute under the authority of the Ministry of Education. The goal of the data collection was to pilot instruments that were developed to evaluate the effects of the program "the Library *at school*". At the first measurement (grades 3 and 5), students completed the reading attitude scale and a number of questions not included in this report. At the second measurement, students completed a questionnaire addressing reading motivation, reading skill, opinion about the school library, parental reading behavior, and frequency of discussing books with parents.

Data analysis

We applied multilevel regression analyses to control for the nesting of the measures: the two time points (level 1) within students (level 2) and the nesting of students within schools (level 3).

Results

Missing data

In total there were 3,599 respondents who filled in the questionnaire at time point 1 and 2,856 of these respondents filled in the questionnaire at time point 2 as well. In addition, there was a group of respondents who filled in the questionnaire at the second, but not at the first time point (n = 625). Based on the number of respondents at the first time point, 20.6% of the respondents dropped out during the study, a percentage comparable to other large scale longitudinal studies in the field of reading

(cf. Allington et al., 2010; Kim & White, 2008). Given that a substantial number of respondents were not included in the final analyses, we tested whether the reading motivation of these respondents differed from the reading motivation of respondents who completed both questionnaires. The reading motivation of students who filled in the questionnaire on the first time point but not on the second time point (M = 16.58, SD = 6.85) was slightly lower than the reading motivation at the first time point of those students who filled in the questionnaire at both time points (M = 17.20, SD = 6.85; t (3597) = 2.17, p = .03, d = .09). There was no difference at the second time point between the students who filled in the questionnaire only at the second time point (M = 16.65, SD = 7.02) and the students who filled in the questionnaire at both points (M = 17.01, SD = 7.16; t (3479) = 1.14, p = .26). In sum, the group of respondents who dropped out of the study seems to be comparable to the group of respondents included in the further analyses.

Descriptive statistics

See Table 1 for an overview of the number of respondents in each cohort, age, gender, and the range of participants per school. The answers on the questions about reading skill, the school library, and adult support are displayed in Table 2. Spearman rank correlations between the study variables at the second time point are provided in Table 3. The negative correlation between cohort and reading motivation (r = -.12) indicates that students in the second cohort (grade 6) were less motivated to read than students in the first cohort (grade 4). Girls were more motivated to read than boys (r = .28), better readers were more motivated to read than less proficient readers (r = .33), students who considered the school library attractive were more motivated to read than students who did not (r = .20), and finally, students who received adult support were more motivated to read than students without adult support (r = .20 for modeling and r = .41 for discussing books). Furthermore, it is noteworthy that older students valued the school library less (r = -.15) and discussed books with their parents less often (r = -.17), that parents who read more also discussed more books with their children (r = .20), and that more discussion about books with parents was related to more appreciation for the school library (r = .16).

Table 1 *School and student characteristics.*

	Grade 3	Grade 4	Grade 5	Grade 6
N	1382	[a]	1474	[a]
M_{age} (SD_{age})	8.34 (.55)	9.27 (.53)	10.39 (.55)	11.31 (.52)
Age range	7-10	8-12	9-12	10-13
% girls	51%	[a]	52%	[a]
K	78[b]	[a]	81[b]	[a]
Range n per school	4-83	[a]	2-59	[a]
Average N per school (SD)	17.72 (12.85)	[a]	18.20 (11.15)	[a]

[a] Identical for grades 3-4 and grades 5-6.
[b] The number of schools differs between the two cohorts and from the total number of schools because no participants remained after applying the exclusion criteria for some schools or grade levels.

Table 2 *Descriptive statistics for the categorical variables.*

Variable	Categories	Percentage of respondents
Reading skill	Not very good	5.6
	Average	55.9
	Very good	38.5
Parental reading behavior	Never	15.3
	Sometimes	42.7
	Often	42.0
Discuss books with parents	Never	43.0
	Sometimes	48.8
	Often	8.2
Opinion about school library	Not attractive	38.4
	Attractive	61.6

Table 3 *Spearman correlations between the reading attitude scale and the independent variables at the second time point.*

	1	2	3	4	5	6	7
1. Reading attitude scale	-						
2. Cohort	-.12***	-					
3. Gender	.28***	.02	-				
4 Reading skill	.33***	-.02	.05*	-			
5. School library	.20***	-.15***	.07***	.03	-		
6. Parental reading behavior	.20***	-.04*	.02	.10***	.03		
7. Discuss books with parents	.41***	-.17***	.12***	.11***	.20***	.16***	-

Intraclass correlation

The intraclass correlation (ICC) is a measure for the variance accounted for by the nested structure of the data. The nesting of time points within individuals is required by the longitudinal design and explained 59% of the variance. The nesting of students within schools resulted in a significant improvement of the model fit (see model 1 and model 2 in Table 4; $\chi^2 = 20.10$, $p < .001$) and explained an additional 2% of the variance in reading motivation. We therefore included a random intercept both at the student and school level in the analyses.

Development of reading motivation

We regressed reading motivation on time (first versus second point of measurement), cohort (younger versus older), gender, reading skill, the students' valuation of the school library, parental reading behavior, and finally the discussion about books

Table 4 *Multilevel regression models with reading motivation as outcome measure.*

	Model 1	Model 2	Model 3	Model 4
Number of parameters	3	4	11	17
Fixed effects				
Intercept	17.10 (.12)***	16.97 (.17)***	7.75 (.38)***	9.03 (.43)***
Time			-.19 (.12)	-2.74 (.40)***
Cohort			-.44 (.21)*	-.13 (.24)
Gender			3.02 (.20)***	2.94 (.23)***
Reading skill			2.88 (.17)***	2.50 (.20)***
School library			1.89 (.23)***	1.34 (.26)***
Parental reading behavior			1.02 (.14)***	.97 (.16)***
Discuss books with parents			2.50 (.17)***	1.72 (.19)***
Time*Cohort				-.63 (.23)**
Time*Gender				.15 (.23)
Time*Reading skill				.74 (.20)***
Time*School library				1.10 (.24)***
Time*Par. Reading behavior				.10 (.16)
Time*Discuss books with par.				1.56 (.19)***
Random effects				
Residual	19.17 (.51)***	19.17 (.51)***	19.14 (.51)***	18.13 (.48)***
Student level	29.91 (1.08)***	28.95 (1.07)***	17.12 (.76)***	17.62 (.76)***
School level		.99 (.36)**	1.19 (.34)***	1.19 (.34)***
Model fit statistics				
-2 Log Likelihood	37,122.55	37,102.45	36,072.26	35,917.81
AIC	37,128.55	37,110.45	36,094.26	35,951.81
BIC	37,148.50	37,137.05	36,167.42	36,064.86

with parents. In addition, the interactions between time and the other independent variables were included to see which factors influence the development of reading motivation. The multilevel regression models are displayed in Table 4. Model 1 is the basic model without predictors and without a random intercept for school; in model 2 we included a random intercept for school. All predictors were included in model 3, while in model 4, we added the interactions between time and the other predictors. Each model fits significantly better than the previous model ($\chi^2 > 20.10$, $p < .001$).

We found main effects for both gender and parental reading behavior. These main effects show that girls are more motivated to read than boys (a difference of approximately 3 points on the reading attitude scale) and that students whose parents model reading behavior tend to be more interested in reading. The lack of an interaction between these factors and time shows that they have no influence on the development of reading motivation. What this means is that, even though girls and children from parents who read more often are more motivated to read, their motivation develops in a similar way to the motivation of boys or children from parents who read less often.

The motivation of not very proficient readers starts to decline halfway through primary school and this decline continues in later grades (see Figure 1). For average readers, motivation remains stable in grades 3 and 4 but starts to decline from grade 5 to 6. Finally, very good readers become more motivated to read from grade 3 to grade 4 and their motivation remains high in grades 5 and 6.

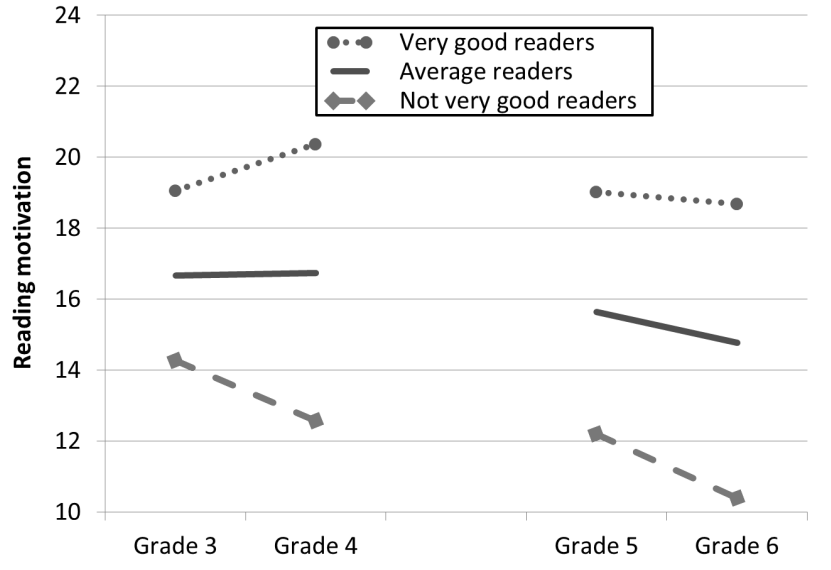

Figure 1. The development of reading motivation for different levels of reading skill.

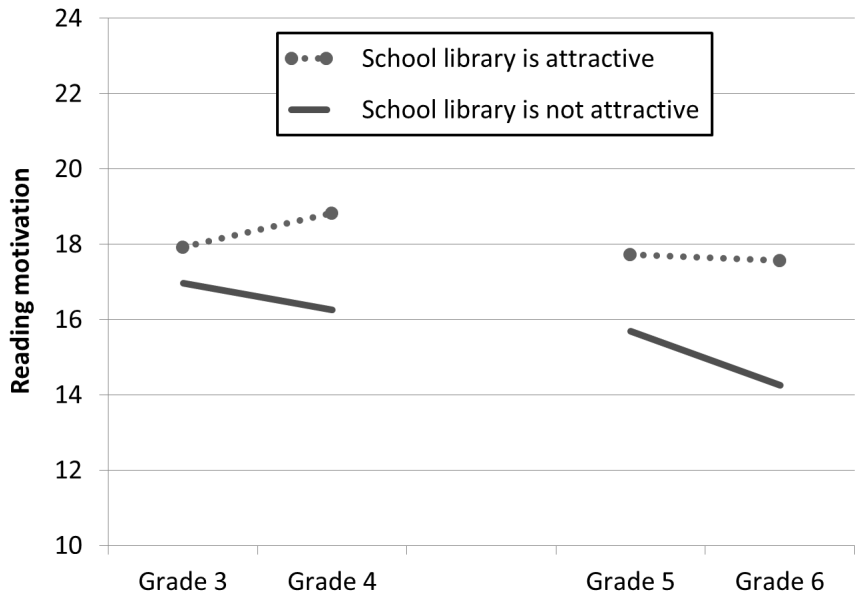

Figure 2. The development of reading motivation for students who think the school library is attractive or not attractive separately.

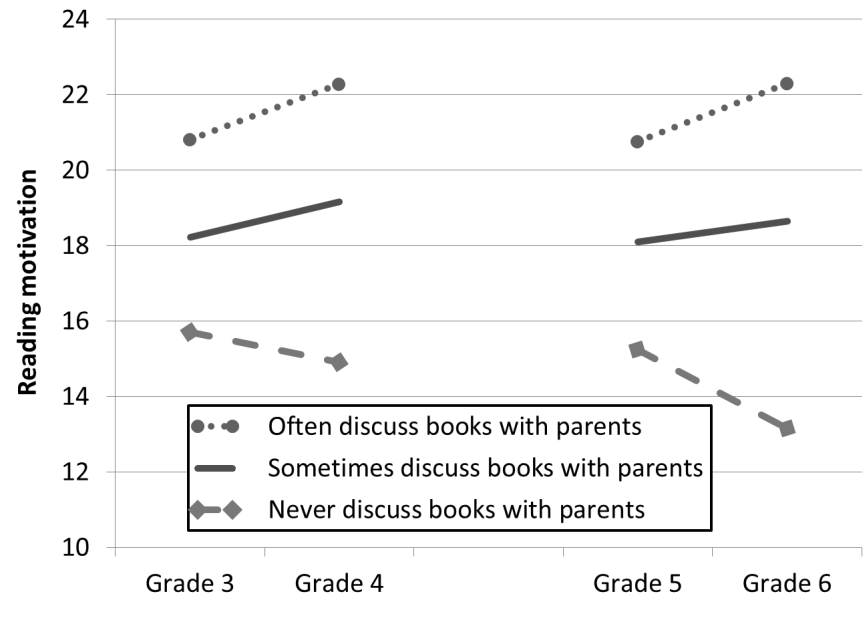

Figure 3. The development of reading motivation for different levels of discussing books with parents.

Figure 2 shows the interaction between the students' evaluation of the school library and the development of reading motivation. The motivation of students who considered the school library to be attractive increased from grade 3 to 4 and remained stable from grade 5 to 6. For students who reported regarding the school library as not attractive, reading motivation declined from grades 3 to grade 4 and from grade 5 to grade 6.

When students reported discussing books with their parents, they were more motivated to read whereas the motivation of children without such experiences declined. Furthermore, the motivation grew stronger when parents often discussed books with their children (see Figure 3).

Discussion

Students' reading motivation declines over the course of primary school. Findings fit the model that less proficient readers are less motivated to read and their reading motivation strongly declines from an early age, whereas students who report being proficient readers are more motivated to read and remain enthusiastic readers (e.g., Mol & Bus, 2011; Morgan & Fuchs, 2007; Stanovich, 1986). The finding that motivation and reading skill are related can be interpreted in various ways but it is most plausible that the relationship is reciprocal (Mol & Bus, 2011). As expected, girls were overall more motivated to read than boys but the development of reading motivation is very similar for boys and girls. Reciprocal relations are also plausible for the relations between reading motivation and the school library. If, for instance, the school library is well-equipped and students can easily find books matching their reading level and interests, this will likely result in more motivation to read. Vice versa, if students are very motivated to read, they are likely to put effort into finding reading materials that interest them even if the school library is poorly equipped. The home environment, though, is a relevant factor as well. Students who discuss books with their parents are more motivated to read than students who do not. However, even when controlling for the home conditions, effects of the school library remain.

The decline in reading motivation may finally result in discontinuation of reading. Half of the Dutch 15-year olds report that they never, or hardly ever, read in their leisure time (OECD, 2010). Many students thus face what Boorstin (1984) described as 'aliteracy': These students have the ability to read but do not practice reading. This lack of reading practice in leisure time has negative consequences for academic and

professional development (Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; OECD, 2010; Taylor, 2013). It is therefore vital to provide more support for students so they become enthusiastic readers.

The current findings corroborate the importance of the school library. It seems obvious that students who are more motivated to read tend to consider the school library as more attractive, because students who like to read will probably put more effort into finding interesting reading materials even in a poorly equipped library (e.g., Clark, 2010). A more surprising outcome is that the development of reading motivation is more positive as students perceive the school library as more attractive. This suggests, in line with Krashen (2011), that access to an attractive book collection is vital for reading motivation. It should be noted, however, that in the present study the attractiveness of the school library is not measured by objective characteristics. It may be interesting to further explore which characteristics of the school library (e.g., the number of books per student, the variety in genres) affect students' reading motivation.

Our findings support the importance of the home environment and in particular discussing books with the parents. Such parental support seems to be a protective factor against the decline in reading motivation at the end of primary school but only occurs in 60% of the homes.

Limitations and conclusion

The main limitation of the present study is that most predictors are measured with a single question at the second time point. Despite this limitation, the present study is the first to provide insight in the development of reading motivation in a large sample in Dutch primary schools. Apart from gender and reading proficiency, we found support for the hypothesis that the quality of the school library makes a difference even after controlling for family literacy (McGeown et al., 2012; Mol & Bus, 2011; Morgan & Fuchs, 2007; Stokmans, 2006). Improvement of the school library seems an important inducement for students to become enthusiastic and skilled readers.

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Chapter 3

Attentional bias toward reading in reluctant readers

Abstract

Is reading subconsciously experienced as a source of threat by reading reluctant (RR) students thus explaining their persistent resistance to reading? In four separate studies (N = 1,205) we used a print exposure checklist to identify RR students in primary education (Grades 4 and 5) and secondary education (Grades 7 and 8) in the Netherlands. The visual dot probe task, commonly used to assess feelings of threat in clinical and health psychology, was applied to reading to test whether RR students indeed selectively attended to reading-related stimuli. Using a meta-analytical approach, we found that RR students scoring zero or below on a print exposure checklist were not only less proficient readers with a more negative attitude toward reading as compared to more enthusiastic readers, but showed an attentional bias toward reading as well. Findings corroborate the theory that about 60% of reluctant readers avoid reading because reading is a source of threat to them. As part of promoting reading we need to find ways to make reading a less threatening activity for those students.

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Reading for pleasure is strongly related to academic and social success (e.g., Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; Mol & Bus, 2011; Nielen & Bus, in press; Notten, 2011; OECD, 2010; Taylor, 2013). Unfortunately, numerous children and adolescents do not read outside school. In a representative sample of Dutch fifteen-year-olds, for instance, half of the adolescents reported that they hardly ever read for enjoyment (OECD, 2010). Due to an accumulation of negative experiences over the course of their school career, reading may become a threatening activity to many students which may keep them from reading for pleasure. This theory that subconscious negative emotions play a role in students' unwillingness to read has not been experimentally tested yet, whereas insights in these processes may yield a new approach for understanding and preventing the development of reading reluctance.

Reluctant readers

The term 'reluctant readers' (RR) is widely used in the literature but its' definition varies. To some researchers it implies the inability to read whereas others view reluctant readers as individuals who have a negative attitude toward reading (Goodwin, 1999). We defined reluctant readers as individuals who do not engage in reading longer stretches of text in their leisure time and avoid free reading in school. This may be because they lack intrinsic motivation as a drive to read (Conradi, Jang, & McKenna, 2014). Research reveals that the desire to avoid reading is one of the characteristics of low motivated readers, who agree with statements as: "Complicated stories are not fun to read" (Wigfield & Guthrie, 1997; Baker & Wigfield, 1999). It should be mentioned that when referring to reading we do not consider the reading of short texts on websites or social media messages, but reading longer stretches of texts as in informative and narrative books.

In line with the above mentioned findings, we hypothesized that reluctant readers avoid reading because they perceive reading as a source of threat just as clinical groups with anxiety disorders avoid social situations, angry looking persons or other sources of threat (e.g., Beidel & Alfana, 2011; Kase & Ledley, 2007; Kerig & Wenar, 2006). This avoidance may cause a chain of negative effects each time these students are confronted with reading. Due to lack of practice they may increasingly experience difficulties with reading age-appropriate materials (including school books), which will further deepen their negative emotions about reading. In addition, there is evidence suggesting that anxiety has a detrimental effect on reading performance. Prefrontal cortex activity is reduced in anxious people, resulting in a failure to use attentional control mechanisms that are needed to process the text content (Bishop, 2009; Eysenck & Derakshan, 2011;

Frewen, Dozois, Joanisse, & Neufeld, 2008). Consequently, students who interpret reading as a source of threat may fail to comprehend and enjoy what they read (e.g., Smallwood & Schooler, 2006; Stern & Shalev, 2013).

Attentional bias

Main aim of this study was to test whether reluctant readers (individuals who do not engage in reading) not only lack reading motivation (Conradi et al., 2014), but also have an emotional resistance toward reading resulting in increasingly avoiding reading. To test the theory that reluctant readers typically show subconscious negative emotions about reading we developed a task that is similar to tasks used in clinical groups suffering from various anxiety disorders. The so-called *visual dot probe task* is based on the assumption that human beings tend to focus on objects or activities that are interpreted as threatening. From an evolutionary point of view individuals pay greater attention to depictions of sources of threat (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007; Mathews & MacLeod, 2002). This is adaptive to the environment in the presence of events that imply real danger (a wasp nearby your drink) but not when non-threatening events like reading are interpreted as source of threat.

The visual dot probe task, originally developed by MacLeod, Mathews, and Tata (1986), is commonly used to assess the attentional bias caused by the tendency in clinical samples to focus on sources of threat (e.g., MacLeod & Mathews, 1988; Waters, Kokkoris, Mogg, Bradley, & Pine, 2010). A potentially threatening stimulus and a neutral stimulus (e.g., an angry and a neutral face) are simultaneously displayed after which a visual probe (an arrow or dot) appears on a new screen at the location of the threatening or neutral stimulus. Because anxious subjects focus their attention on sources of threat they respond quicker to probes at the location of threatening stimuli than to probes at the location of neutral stimuli causing an attentional bias toward the source of threat. In contrast, non-anxious subjects are not specifically focusing on the threatening stimuli and will therefore respond equally fast to probes at the location of threatening and neutral stimuli. Hence, they are not biased toward the potentially threatening stimuli.

There is strong support for the use of the *visual dot probe task* to assess anxiety in clinical and non-clinical samples. Meta-analytical evidence shows that anxious children and adults have an attentional bias toward threat-related stimuli whereas non-anxious individuals display no attentional bias. In other words, subjects suffering from some form of anxiety typically show an attentional bias toward threatening

stimuli (Bar-Haim et al., 2007; Schoth, Nunes, & Liossi, 2012). This is, to the best of our knowledge, the first study in which the visual dot probe task was adapted to the domain of reading to assess negative emotions about reading.

Present study

This study aims at testing: *To what extent do reading reluctant students have an attentional bias toward reading?* We studied our question in four separate studies. We focused on the higher grades of the Dutch primary school system (9-12 year olds) as well as the first grades of secondary education (11-15 year olds). We focused on this age range because these children vary more in how often they read than younger children in the first grades of primary school (Mol & Bus, 2011). To identify individuals who do not engage in reading (reluctant readers) in our four studies, we focused on pupils who discontinued reading longer stretches of texts as appears from their unfamiliarity with book titles for their age range; for this we used a Title Recognition Test which is considered to be an unobtrusive measure for reading longer stretches of text (e.g., Stanovich & West, 1989; Stanovich, 2000). The fact that participants are made aware of the presence of fake items in a title recognition test may prevent social desirable answers and, different from reading-frequency questionnaires, the title recognition test does not include ambiguous items or retrospective reports (Mol & Bus, 2011). We validated our selection of reluctant readers by examining whether they differed from their more enthusiastically reading peers on reading motivation and reading skills.

Because existing literature (e.g., Bradley, Mogg, Falla, & Hamilton, 1998; Waters et al., 2010) is inconclusive about visual dot probe task elements like the qualities of picture stimuli and the duration of presenting picture pairs (500 ms versus > 1,000 ms), we have built in checks on the validity of our choices by presenting two versions of the task in one of the studies. In addition, we have tested whether students perceive the reading pictures as related to reading and report both the attentional bias scores for all pictures and with exclusion of pictures that were not clearly related to reading according to the participants.

We expected more reluctant readers and negative emotions about reading in secondary school than in primary school because the attitude toward reading gradually grows more negatively over the course of primary and secondary school (Nielen & Bus, 2013; OECD, 2010). As students in the pre-academic track are known to be better skilled and more engaged readers than students in the pre-vocational track (CITO, 2010; Mol & Jolles, 2014) we expected more reluctant readers and negative emotions about reading in the pre-vocational track. Because girls read more, are better readers

and are more motivated to read for pleasure than boys (e.g., Logan & Johnston, 2009; OECD, 2010), we expected that more boys than girls would be reluctant readers and would show an attentional bias toward reading. By meta-analyzing results of the four studies we accounted for possible influences of these background variables and may gain insight in risk groups for reading reluctance.

As tryouts the visual dot probe task was included in the pretest of an intervention study in primary education (study 1) and administered to a relatively small group of boys in the pre-academic track of secondary school (study 4). The promising results were reason for carrying out more elaborate studies among primary school students (study 2) and students in pre-vocational education (study 3).

Method

Design

In four separate correlational studies, data about an attentional bias (AB) toward reading were collected. In all studies we have used unfamiliarity with popular book titles as indicator of reading reluctance. As scores of zero and below on the Title Recognition Test (TRT) indicated that students were not familiar with any age-appropriate book titles and that they had just been guessing we defined students scoring in this range as reluctant readers. To validate this criterion for selecting reluctant readers we also collected reading attitude and reading skill data in each study. We included a total of 605 students in the upper grades of primary school in studies 1 and 2, and a total of 600 secondary school students in the lower, pre-vocational educational track (VMBO) and the higher, pre-academic educational track (HAVO, VWO) in studies 3 and 4. From the tryouts in primary (study 1) and secondary education (study 4) appeared that only a small proportion of students was not at all familiar with book titles (about 10%) indicating that they do not read for pleasure. To compose larger groups of about 50 reading reluctant students in follow-up studies we had to test 450-600 students (studies 2 and 3). An overview of the initial and final number of participants, the grade, age and gender for each study are displayed in Table 1.

Table 1 *Characteristics of samples in all four studies.*

Study	$N_{initial}$	N_{final}	$N_{schools}$	School type	Grade(s)	M_{age}	SD_{age}	% males
1	147	146	21	Primary	5	11.11	.53	52
2	474	459	10	Primary	4 & 5	10.26	.67	47
3	629	500	5	Pre-vocational	7	12.43	.54	48
4	100	100	4	Pre-academic	7 & 8	12.78	.84	100

Note. $N_{initial}$ = The initial number of participants. N_{final} = The number of participants included in the analyses (see the procedure section for exclusion criteria).

Instruments

Title recognition test. A print exposure checklist was used to measure familiarity with book titles appropriate for students' age range (Stanovich & West, 1989). Participants were asked to check existing titles among a list of titles of popular and classic books that also included fake titles. To prevent guessing participants were told that the checklist contained foils. The final score equaled the proportion of correctly identified titles minus the proportion of checked foils. A high score thus taps into knowledge about literature that is acquired by reading books and visiting libraries and bookstores.

Each list contained about 50 titles among which one-third were foils (α range: .81 - .89). The originally Dutch or translated books were selected from Dutch sales records of a large webshop (www.bol.com) and library loan records. Because students in pre-academic secondary education are known to be relatively good readers for their age (e.g., CITO, 2010) we selected books in the category 12+ and some books in the category 'young adults'. For the generally lower-skilled readers in pre-vocational secondary education (CITO, 2010), however, we selected mainly books from the 9-12-year-old category, just as in primary education.

Visual dot probe task. This task included 136 trials: 8 practice trials, 32 filler trials and 96 experimental trials. The experimental trials were created by selecting 12 reading-related and 12 neutral pictures. The reading and neutral pictures in each stimulus pair were matched on the presence of humans or animals and the position and color of the main objects to make them as far as possible alike. Filler items (four pairs of neutral pictures) were included to distract participants from the nature of the task. The same set of pictures were used in studies 1, 2, and 3. In study 4, we included pictures that were less playful than the ones used in the groups with younger or lower performing students (see Figure 1 for examples).

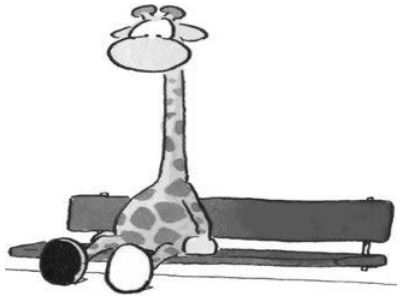
Picture pairs	
A. Reading pictures studies 1-3	Neutral pictures studies 1-3
	
	
B. Reading pictures study 4	Neutral pictures study 4
	
	

Figure 1. Examples of picture pairs in the visual dot-probe task for studies 1-3 (A) and study 4 (B). Study 4's neutral-matched pictures were taken from the International Affective Picture System (5500,7081, 7242, 7950, 7077, 7547, 7035, 7038, 7354, 7034, 7041, & 7150) and had to have valence scores between 4 and 6 and arousal scores lower than 5 on scales from 1 to 9 (Lang, Bradley, & Cuthbert, 2008).

Each trial included subsequently (a) a screen with a fixation cross in the center appearing for 500 milliseconds (ms), (b) a screen with a picture-pair appearing for 500 ms (study 2) or 1,500 ms (all studies) and (c) a screen showing an arrow (i.e., visual probe) pointing to the left or right located at the top or bottom half of the screen (see Figure 2). The probe remained on the screen until the participant had responded. The inter-trial interval varied randomly between 1,000 and 1,500 ms and a break occurred after completion of 32 trials. All screens had a bright-blue background. Full-color pictures (24-bit, 326 x 244 pixels) were centered at the upper or lower part of the computer screen, that is, the center of the pictures at 70% and 30% of the screen height, respectively. The task was presented in E-prime (2.0; studies 1, 2 and 4) or OpenSesame (Mathot, Schreij, & Theeuwes, 2012; study 3).

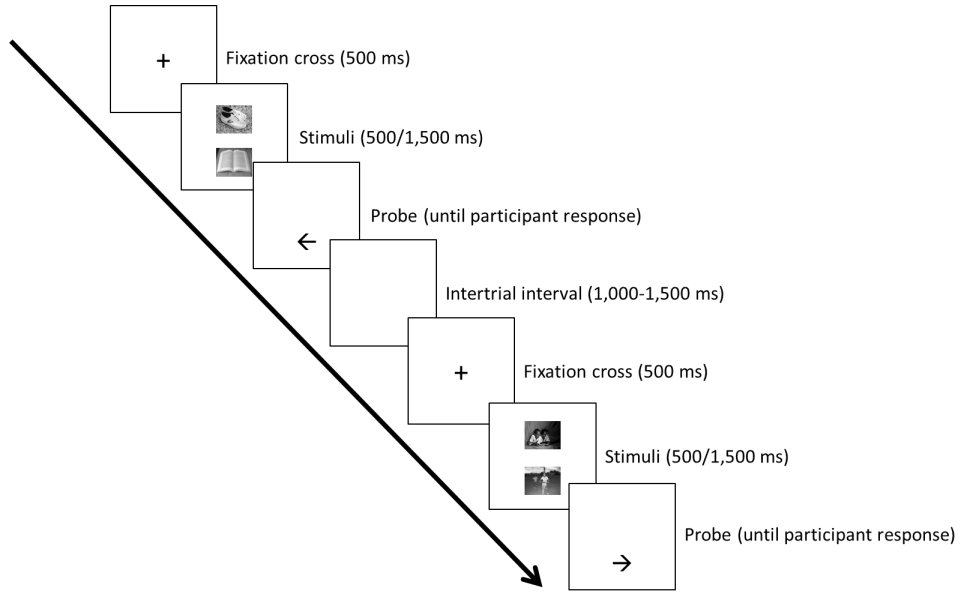


Figure 2. Two exemplary trials of the visual dot-probe task. In the first example the probe (arrow pointing left) appeared in the position of the reading picture and in the second (arrow pointing right) in the position of the neutral picture. Each trial started with a fixation cross (duration 500 ms) and subsequently two pictures were presented for 1,500 ms (only in study 2 we also tested a version of the AB task in which pictures were presented for 500 ms). After the pictures had disappeared an arrow appeared and participants were stimulated to respond as quickly as possible by indicating the direction of the arrow. After the participant had responded, an intertrial interval (blue screen) with a random duration between 1,000 and 1,500 ms was presented prior to the start of the next trial.

Each reading/neutral-picture pair was presented eight times. Both reading pictures (i.e., targets) and probes appeared in the upper or lower position with equal probability, with the arrow pointing to the left in 50% of all trials. Most importantly, the probe appeared as often in the position of the reading picture (upper-probe/upper-target and lower-probe/lower-target) as in the position of the neutral picture (upper-probe/lower-target and lower-probe/upper-target). Fillers (neutral/neutral-picture pairs) were randomly interspersed among reading/neutral-picture pairs and were also presented eight times, equally distributed over probe positions (upper/lower).

Students were instructed to indicate, as quickly as possible, whether the arrow pointed to the left or right. The younger participants in studies 1 and 2 were told to keep the index finger of their right hand on the arrow to the right (a "→" sticker on the letter "L" of the keyboard) and the index finger of their left hand on the arrow to the left (a "←" sticker on the letter "A" of the keyboard) and to press the arrow corresponding to the arrow on the screen. In the older samples, students were instructed to press "A" when the arrow pointed left and "L" when the arrow pointed right. Participants' responses, response accuracy, and response latencies as well as all trial-characteristics (e.g., picture-pair number, probe/target position) were registered for each trial. Participants started with eight practice trials (with neutral/neutral-picture pairs). Attentional bias scores were based on the "single index" formula that accounts for the location, upper or lower part of the screen, where the arrow is presented (MacLeod & Mathews, 1988): *((upper probe/lower target – upper probe/upper target) + (lower probe/upper target – lower probe/lower target))/2*. If the reading related pictures (targets) attract most attention response time would be faster for upper probe/upper target as compared to upper probe/lower target. Likewise, the response time for lower probe/lower target would be faster as compared to lower probe/upper target. The formula would thus reveal average scores above zero if a participant focuses his or her attention on the reading related pictures but scores around zero if there is no preference for neutral or reading related pictures. A positive score thus reflects an attentional bias toward reading targets, whereas a score around zero reflects no special preference for reading or neutral targets. If neutral pictures attract most attention response time would be faster for probes at the same location as the neutral pictures resulting in an attentional bias toward neutral targets (and a negative attentional bias score).

Reading attitude. In studies 1, 2, and 3, we used the Dutch "Reading Attitude Scale" (Aarnoutse, 1990), containing 27 items with dichotomous answer categories (yes/no), such as "Do you think books are boring?". In study 4, students' responded to 10 comparable items on a 4-point Likert scale ranging from 'completely disagree' till

'completely agree'. In line with validation studies (COTAN, 1996) the alpha reliability was satisfactory in all four studies ranging from α = .83 to α = .93. Higher scores reflected a more positive attitude toward reading.

Picture evaluation task. Participants rated the 12 reading-related and neutral-matched pictures used in the dot probe task. We asked them how attractive they considered the pictures on a scale from not attractive at all (score = 1) up till very attractive (maximum score of 6 in studies 1, 2 and 3; maximum of 10 in study 4). The scores in study 4 were afterwards recoded to match the 1-6 ratings in the other studies. We used the rating of the reading pictures to assess the suitability of the pictures for the attentional bias task. Furthermore, we distracted the average rating of neutral pictures (alpha range: .63 - .75) from the average rating of reading pictures (alpha range: .90 - .94) as an indication of reading attitude. Higher scores indicated a more positive rating of the reading pictures compared to the neutral pictures which was seen as an indication of a more positive attitude toward reading.

Reading skill. A standardized reading comprehension test (Cito Reading Comprehension; Feenstra, Kamphuis, Kleintjes, & Krom, 2010; Weekers, Groenen, Kleintjes, & Feenstra, 2011) is part of the assessment program in the Dutch primary school system. We obtained participating students' test results from their teachers, who have access to the classroom's database including these standardized test scores. Students scored in one of the following five categories: 0 = lowest 10%, 1 = 15% well below average, 2 = 25% right below average, 3 = 25% right above average, and 4 = highest 25%.

For secondary school students no standardized tests were available. As an indicator of reading skill in secondary school students indicated answers to five questions such as: "How well can you read?" and "Are you able to read quickly and easily?" on a four-point scale (study 3: α = .75; study 4: α = .71). A higher score indicated a better reading skill.

Procedure

Data were collected by the first author in studies 1-3 and by the second author in study 4 after receiving informed consent from parents. Main researchers were assisted by trained Bachelor or Master students. In studies 1 and 4 we administered the visual dot probe task in individual test sessions (15 minutes). In study 2, there were two separate, individual sessions (for 500 and 1,500 ms) with approximately one week in between. The order of administration was counterbalanced between participants. In all studies questionnaires, including the title recognition test, reading attitude scale,

picture evaluation task and, only in secondary school the reading skill questionnaire, were administered during group meetings (30-45 minutes), in study 1 and 2 after and in study 4 before administering the dot probe task. In study 3, all data were collected group wise in a single test session (40-50 minutes) in the school's computer room starting with the dot probe task.

Statistical analyses

Data was not analyzed until the entire data collection for a study was finished. We first calculated average attentional bias (AB) scores of the full samples to examine whether some groups as a whole responded negatively toward reading. Second, we made a distinction between reading reluctant (RR) and more reading enthusiast (RE) students and described the differences between RR and RE students on AB scores, reading attitude, picture evaluation, and reading skill. We analyzed this for boys and girls separately, resulting in seven comparisons between RR and RE students (two comparisons in studies 1, 2 and 3, one comparison in study 4 that included merely boys). Finally, we used a meta-analytical procedure to compare the overall difference in reading attitude, picture evaluation, reading skill and AB between RR and RE students. Means and standard deviations for the seven comparisons were inserted in the Comprehensive Meta-Analysis software version 2.0 (Borenstein, Hedges, Higgins, & Rothstein, 2005). The main advantage of a meta-analytical approach is that it allows to draw conclusions based on a quantitative summary of the trends across separate studies (cf. Bus, Leseman, & Neuman, 2012). This approach provides a more robust estimate of the effects than the separate studies in which the significance of the results is strongly dependent on, amongst other things, sample size (cf. Cumming, 2014).

Results

Due to student absence during a test session or technical issues, we had to exclude 1 student from study 1 (.7%) and 15 students from study 2 (3.2%). In study 3 not all students took the tests seriously and we excluded 129 participants (20.5%) who had checked more than one-third of the fake titles in the Title Recognition Test (TRT) and/or performed at chance level (based on the number of mistakes) on the visual dot probe task.

Validation of the attentional bias task

An important aspect of the attentional bias (AB) task is the selection of appropriate stimuli. It is important to check whether the participants actually associated the reading pictures to reading. We examined therefore whether the rating of individual pictures was correlated with the reading attitude scale assuming that correlations should be rather high when students indeed perceived pictures as being related to reading. Therefore, in addition to the AB score for all included items (i.e., uncorrected AB score), we calculated a corrected AB score based solely on the pictures that correlated at least medium high ($r \geq .30$) with reading attitude. This criterion resulted in the exclusion of two reading pictures in study 1, none in study 2, three in study 3, and three in study 4. As the neutral pictures were all rated around the mean of the 6-point scale ($M_{neutral} = 3.47$, $SD = 1.60$) we assumed that none of these pictures revealed extreme emotions.

In study 2 we compared two versions of the visual dot probe task that differed in stimulus duration. When stimuli were presented for 500 ms we did not find an AB for the overall group ($d = -.01$, 95% CI [-.10, .08], $p = .88$) nor a significant contrast between RR and RE for boys ($d = -.09$, 95% CI [-.41, .23], $p = .59$) or girls ($d = .14$, 95% CI [-.20, .49], $p = .42$). For 1,500 ms, we found no AB for the overall group ($d = .00$, 95% CI [-.09, .09], $p = .95$) nor for the contrast between RR girls and RE girls ($d = -.01$, 95% CI [-.36, .34], $p = .94$) but we did find an AB for RR compared to RE boys ($d = .37$, 95% CI [.05, .69], $p = .02$). This finding supports the choice to present pictures for 1,500 ms in the other three studies.

Attentional bias toward reading

Following other studies applying the visual dot probe task (e.g., Mogg, Wilson, Hayward, Cunning, & Bradly, 2012; Wolters, de Haan, Vervoort, Hogendoorn, Boer, & Prins, 2012) we removed incorrect trials (wrong response to the probe; 3.0-4.3%), extreme outliers that were either faster than 200 ms or slower than 1,200 ms (0.6-1.7%), and reaction times that deviated more than 3 standard deviations from a participant's mean (0.2-0.8%) prior to the AB score calculation. In study 2 and 3 the AB score of one participant was extremely high and therefore winsorized.

Next, we calculated each study's overall, average AB by combining the scores of all included students per sample. With one-sample *t*-tests we tested for each study whether the overall AB toward reading stimuli significantly exceeded zero; see Table 2 for an overview. In primary education we did not find overall significant AB toward reading stimuli (neither in study 1: $AB_{uncorrected}$ $d = .03$, 95% CI [-.14, .19], $p = .75$;

$AB_{corrected}$ d = .07, 95% CI [-.09, .23], p = .40 nor in study 2: $AB_{uncorrected}$ d = .00, 95% CI [-.09, .09] p = .94. For the pre-vocational track of secondary education (study 3), we found an AB toward reading stimuli ($AB_{uncorrected}$ d = .16, 95% CI [.07, .25], p < .001; $AB_{corrected}$ d = .22, 95% CI [.13, .31], p < .001). For the pre-academic track results were inconclusive. Based on the uncorrected AB score (d = .25, 95% CI [.05, .45], p = .02) there was an overall AB toward reading stimuli, but this did not appear to be the case for the corrected AB score (d = .13, 95% CI [-.07, .32], p = .21).

Table 2 *Overview of AB scores for each study.*

Study	AB	*M*	*SD*	*t*	*df*	*p*	*d*	95% CI for *d*
1	Uncorrected	.60	22.82	.32	145	.75	.03	-.14, .19
1	Corrected	1.89	26.80	.85	145	.40	.07	-.09, .23
2[a]	Uncorrected	.09	24.54	.08	466	.94	.00	-.09, .09
3	Uncorrected	3.83	23.67	3.62	499	<.001	.16	.07, .25
3	Corrected	6.89	31.32	4.92	499	<.001	.22	.13, .31
4	Uncorrected	4.59	18.51	2.48	99	.02	.25	.05, .45
4	Corrected	2.75	21.68	1.27	99	.21	.13	-.07, .32

[a] No pictures had to be excluded in study 2 and therefore no corrected AB score is available.

Contrasts between RR and RE students

Students were identified as reading reluctant (RR) when they were not familiar with any age-appropriate book titles. As shown in Table 3, 10 to 20 percent of students scored zero or lower. If students recognized one or more titles correctly we took this as indicator for some familiarity with books.

Table 3 *Number of reading reluctant and more enthusiastically reading students in each study.*

Study	Gender	School type	Grade(s)	N_{total}	N_{RR}	N_{RE}	% RR
1	Boys	Primary	5	70	11	59	16
1	Girls	Primary	5	76	6	70	8
2	Boys	Primary	4 & 5	216	50	166	23
2	Girls	Primary	4 & 5	243	37	206	15
3	Boys	Pre-vocational	7	239	173	66	72
3	Girls	Pre-vocational	7	261	164	97	63
4	Boys	Pre-academic	7 & 8	100	7	93	7

Note. RR-students were identified based on a TRT-score of zero or lower, except for study 3 where we selected the 33% highest scoring students as RE.

In studies 1, 2 and 4 the distinction based on a cutoff score of 0 on the TRT resulted in higher AB's in the RR group than the RE group, as will be specified hereafter. In study 3 both RR and RE students showed an AB that significantly deviated from zero or approached significance ($d_{RR\ uncorrected}$ = .17, 95% CI [-.03, .37], p = .095, $d_{RR\ corrected}$ = .25, 95% CI [.05, .46], p = .015; $d_{RE\ uncorrected}$ = .16, 95% CI [.06, .26], p = .002, $d_{RE\ corrected}$ = .21, 95% CI [.11, .31], p < .001). This suggests that the majority of students in prevocational education showed an attentional bias. We hypothesized that due to the inclusion of titles for younger students positive TRT-scores in study 3 may also reflect reading behavior in earlier grades and not just students' current reading behavior, in contrast to the TRT in studies 1, 2 and 4 with only books for the target age. We have addressed this flaw in the design of study 3 by moving up the cut-off score till the AB of the students scoring in the lower range on the TRT differed from the AB of students who were more familiar with the books on the TRT. When contrasting the 33% highest scoring students on the TRT with the rest, the AB of the RR group ($d_{uncorrected}$ = .19, 95% CI [.09, .30], p < .001; $d_{corrected}$ = .29, 95% CI [.18, .40], p < .001) was higher than the AB in the RE group ($d_{uncorrected}$ = .10, 95% CI [-.06, .25], p = .209; $d_{corrected}$ = .09, 95% CI [-.07, .24], p = .279). In other words, the 33% highest scoring students on the TRT were the only ones who did not display an AB toward reading in the pre-vocational track of secondary school.

In secondary school the percentage RR students in the pre-academic track (7%) was, despite that this study included only boys, much smaller than the percentage in the pre-vocational track in study 3 (67%). In so far studies included boys and girls the percentage of RR girls was lower than the percentage of RR boys; percentages differed significantly in studies 2 and 3 (χ^2 > 4.67, p < .032) albeit that differences were small according to the phi coefficients (Phi = .10 in both studies).

Differences between RR and RE students

In addition to examining differences in AB between RR and RE students, we aimed to examine whether our groups differed on the other reading measures as well. We compared RR and RE students on the title recognition test, reading attitude, picture evaluation, reading skill, and the AB scores (uncorrected and corrected) (see Table 4).

Because students were selected based on the title recognition test the differences between RR and RE students on this measure are as large as two to three standard deviations. In general, the direction of the effects found on the other measures is as expected; RR students tended to have a more negative reading attitude, evaluated the reading pictures more negatively than the neutral pictures, tended to be poorer

Table 4 *Comparison of RR and RE individuals on reading attitude, picture evaluation, reading skill and AB scores.*

Study	Gender	Measure	Total			Reading Reluctant (RR)			Reading Enthusiast (RE)			*d* [d]	*p* [e]
			N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*		
1	Boys	Title recognition test	70	11.60	13.30	11	-7.69	5.80	59	15.19	10.99	-2.20	<.001
		Reading attitude	70	17.34	7.16	11	16.36	6.43	59	17.52	7.32	-.16	.63
		Picture evaluation	70	.22	1.12	11	.14	1.06	59	.24	1.14	-.09	.81
		Reading skill	70	2.39	1.24	11	2.00	1.34	59	2.46	1.22	-.37	.27
		AB uncorrected[a]	70	-1.93	24.39	11	10.56	32.14	59	-4.56	22.24	.62	.17
		AB corrected[b]	70	.89	27.61	11	13.39	33.00	59	-1.92	26.11	.56	.09
1	Girls	Title recognition test	76	18.19	13.71	6	-9.28	6.02	70	20.51	11.43	-2.67	<.001
		Reading attitude	76	19.91	6.92	6	21.44	6.34	70	19.78	7.00	.24	.58
		Picture evaluation	76	.72	1.01	6	.97	.96	70	.69	1.01	.28	.52
		Reading skill	76	2.62	1.15	6	1.83	.75	70	2.69	1.16	-.76	.08
		AB uncorrected[a]	76	2.92	21.17	6	18.16	28.91	70	1.61	20.11	.79	.07
		AB corrected[b]	76	3.18	26.15	6	20.61	36.36	70	1.68	24.88	.73	.09
2	Boys	Title recognition test	216	5.53	10.49	50	-8.01	8.86	166	9.61	6.91	-2.38	<.001
		Reading attitude	216	14.92	7.35	50	13.99	7.55	166	15.20	7.29	-.16	.31
		Picture evaluation	216	.29	1.29	50	-.09	1.41	166	.41	1.23	-.39	.02
		Reading skill	202	2.43	1.24	47	2.09	1.20	155	2.54	1.24	-.37	.03
		AB uncorrected[ac]	216	.71	25.12	50	7.73	25.77	166	-1.41	24.60	.37	.02
2	Girls	Title recognition test	243	10.30	11.55	37	-8.10	8.98	206	13.60	8.44	-2.55	<.001
		Reading attitude	243	17.19	7.79	37	17.08	7.23	206	17.21	7.90	-.02	.92
		Picture evaluation	243	.71	1.17	37	.70	1.29	206	.71	1.15	-.01	.94
		Reading skill	224	2.54	1.20	35	2.03	1.36	189	2.63	1.14	-.51	.01
		AB uncorrected[ac]	243	-.50	24.36	37	-.76	28.73	206	-.45	23.57	-.01	.94
3	Boys	Title recognition test	239	6.45	8.40	173	2.38	4.73	66	17.11	6.27	-2.83	<.001
		Reading attitude	239	11.01	7.34	173	10.12	7.16	66	13.35	7.32	-.45	.002
		Picture evaluation	237	-1.07	.92	172	-1.11	.95	65	-.97	.84	-.15	.30
		Reading skill	239	9.80	2.64	173	9.68	2.57	66	10.14	2.80	-.17	.25
		AB uncorrected[a]	239	2.22	24.47	173	2.58	24.02	66	1.29	25.79	.05	.71
		AB corrected[b]	239	6.94	32.57	173	8.99	32.24	66	1.58	33.08	.23	.12
3	Girls	Title recognition test	261	9.09	8.50	164	3.93	4.21	97	17.83	6.53	-2.68	<.001
		Reading attitude	259	13.08	7.86	162	12.29	7.66	97	14.41	8.05	-.27	.04
		Picture evaluation	260	-1.14	.92	163	-1.21	.95	97	-1.03	.86	-.20	.12
		Reading skill	259	9.80	2.73	162	9.49	2.72	97	10.31	2.68	-.30	.02
		AB uncorrected[a]	261	5.30	22.86	164	6.53	22.15	97	3.22	23.99	.14	.26
		AB corrected[b]	261	6.85	30.20	164	8.76	28.38	97	3.63	32.94	.17	.19
4	Boys	Title recognition test	100	9.96	6.56	7	-1.05	1.78	93	10.78	6.02	-2.02	<.001
		Reading attitude	100	25.57	5.91	7	23.29	4.35	93	25.74	5.99	-.42	.29
		Picture evaluation	100	-.29	.91	7	-.81	.43	93	-.25	.92	-.62	.12
		Reading skill	100	8.64	3.59	7	8.86	3.81	93	8.62	3.60	.07	.87
		AB uncorrected[a]	100	4.59	18.51	7	12.23	19.69	93	4.01	18.40	.44	.26
		AB corrected[b]	100	2.75	21.68	7	19.73	19.34	93	1.48	21.39	.86	.03

[a] Uncorrected AB score was based on the complete set of pictures presented to the participants. [b] The corrected AB score was based on reading pictures that were related to the reading attitude scale ($r > .30$), suggesting that participants associated those pictures with reading. [c] None of the pictures had to be excluded in study 2 so no corrected score was available for this study. [d] The effect size (*d*) for the comparison of the RR and RE groups. [e] Based on independent samples *t*-tests, assumptions for the analyses were met.

readers, and had higher AB scores. In primary school RE students appeared to have better reading skills than RR students. In secondary school the reading attitude of RE students was higher than the reading attitude of RR students. The lack of significant differences in study 1 and 4 on the reading attitude and reading skill measures may be a consequence of the small number of reluctant readers ($n_{boys} = 11$, $n_{girls} = 6$ in study 1 and $n = 7$ in study 4). Nevertheless, results were in line with findings in studies 2 and 3. It is also worth noting that girls mainly scored higher on the attitude measures, but that gender differences were much smaller for reading skill (cf. Logan & Johnston, 2009).

Meta-analytic evidence

Following a meta-analytical procedure we combined all results reported above contrasting the RR and RE students on reading attitude, picture evaluation, reading skill and the two AB scores. We used fixed-effect models because we expected similar effect sizes for differences between RR and RE students in the four studies (Borenstein, Hedges, Higgins, & Rothstein, 2009). For results of the comparisons between RR and RE students, see Figure 3. As expected, RR students were significantly less motivated to read (d = -.24, 95% CI [-.38, -.10], p = .001), were less positive about the reading pictures (d = -.19, 95% CI [-.33, -.05], p = .008) and were less proficient readers than RE students (d = -.32, 95% CI [-.46, -.18], $p < .001$). The overall effect size for the AB score in the current studies ($d_{uncorrected}$ = .19, 95% CI [.05, .33], $p < .008$ and $d_{corrected}$ = .25, 95% CI [.11, .39], $p < .001$) was, though a bit lower, consistent with effect sizes found in two meta-analyses comparing anxious individuals with controls (Bar-Haim et al., 2007; Schoth et al., 2012); see bottom two effects in Figure 3.

Exclusion of pictures that were not perceived as being related to reading by the students in the present studies resulted in a slightly larger difference between RR and RE students in terms of AB (d = .19 versus d = .25). When comparing the difference in AB score between RR and RE students for the four subsamples with boys and the three subsamples with girls separately, the averaged effect sizes showed that the difference was higher for boys ($d_{uncorrected}$ = .25, 95% CI [.05, .44], p = .013; $d_{corrected}$ = . 35, 95% CI [.16, . 55], $p < .001$) than for girls ($d_{uncorrected}$ = .13, 95% CI [-.07, .33], p = .198; $d_{corrected}$ = .14, 95% CI [-.06, . 34], p = .159) but the gender effect did not reach significance ($Q_{uncorrected}(1) = 0.43$, p = .51; $Q_{corrected}(1) = 1. 49$, p = . 22).

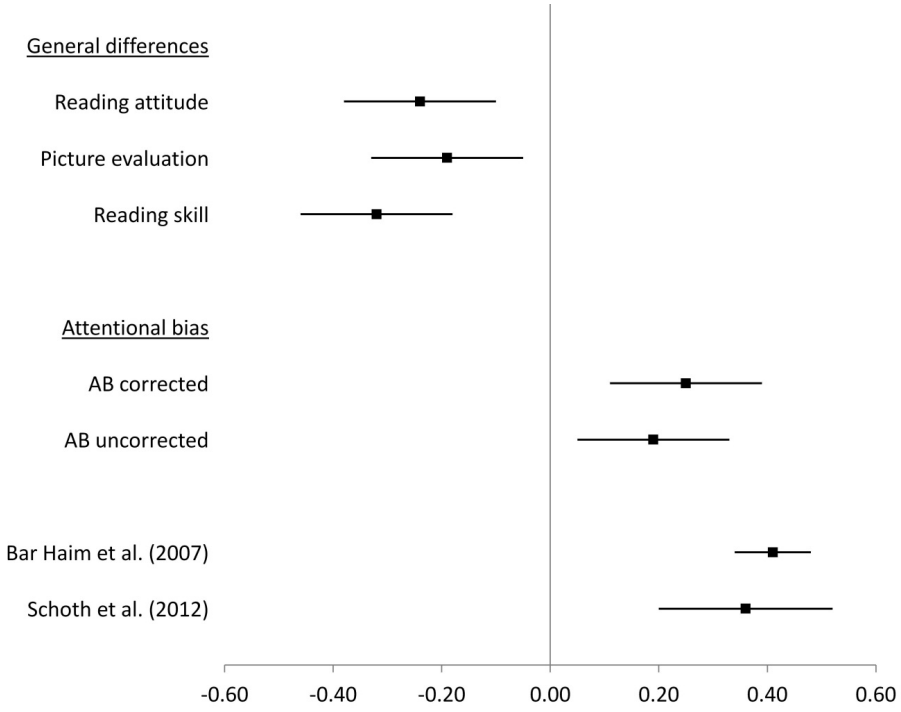


Figure 3. Meta-analytical differences between RR and RE students on general features (reading attitude, picture evaluation and reading skill) and AB scores; for comparison of effect sizes we added the combined AB effect for stress disorders (Bar-Haim et al., 2007) and chronic pain (Schoth et al., 2012). All presented effects were significant ($p < .01$).

Discussion

In four studies we addressed the question whether students rarely read because they experienced reading as a threat and showed an attentional bias toward reading. Over 1,200 students in Grades 4, 5, 7 and 8 completed the visual dot probe task with reading-related and neutral stimuli. The main finding was that in typical groups in primary and secondary education quite a few students showed an emotional resistance toward reading stimuli. In these groups, the reading reluctant readers, i.e., readers who rarely read books and scored relatively low on reading motivation and reading proficiency, showed an attentional bias toward reading that is indicative for negative emotions about reading. A meta-analytical approach combining the results of seven contrasts showed a larger attentional bias toward reading pictures in the group of RR students

as compared to the RE students. To our best knowledge, the current studies are the first to address subconscious negative emotions about reading as a correlate of reading reluctance on a non-behavioral level. The effect size for the RR students ($d_{corrected}$ = .19 versus $d_{corrected}$ = .25) indicates that approximately 60% of this group displayed a bias toward reading stimuli (Cohen, 1988). In other words, not all but a majority of RR students displayed an attentional bias meaning that they developed emotional resistance toward reading. This finding corroborates the hypothesis that emotional resistance is one of the factors contributing to reading reluctance that has to be taken into account to prevent and remediate aliteracy, that is, not practicing reading despite the ability to read (Boorstin, 1984).

We also found support for the hypothesis that particularly lower performing students with a long history of negative experiences perceive reading as a source of threat. In fact, the majority of students in the pre-vocational track of secondary school (67%) that are known to be rather poor in reading proficiency throughout their school career had developed an attentional bias toward reading. In higher performing students attending the pre-academic track of the Dutch secondary school system, by contrast, only a small minority (7%) did not read books and experienced reading as threatening, even though we only included boys who have been shown to be more reading reluctant than girls (e.g., OECD, 2010).Furthermore, we found small gender differences in the prevalence of reading reluctance. Across our studies, more boys than girls were classified as reluctant readers. When we aggregated all effect sizes contrasting RR- and RE-groups of boys (four subsamples) and girls (three subsamples), we did not find that boys on average held significantly larger attentional biases than girls, however.

Implications and recommendations

The effect size of the attentional bias in reluctant readers (d AB$_{uncorrected}$ = .19, d AB$_{corrected}$ = .25) is lower than effect sizes for attentional bias in chronic pain (d = .36, Schoth et al., 2012) and in anxious individuals (d = .41, Bar-Haim et al., 2007). We might find more similar effect sizes if, in line with the bulk of attentional bias research, target groups would have a long history of serious negative experiences with reading. Future studies may therefore involve more extreme groups like illiterate or low-literate adults or students with severe reading disabilities. Showing attentional bias in extreme groups like illiterates might also help explain why it is so difficult to motivate illiterate adults to practice reading and improve their reading performance (EU high level group of experts on literacy, 2012).

Especially our findings in the pre-vocational educational track of secondary school are alarming: the majority of students in this track perceive reading as a threatening activity. Due to the correlational nature of our data we cannot draw causal conclusions, but it is plausible to assume that negative emotions about reading contribute to a downward spiral (Ackerman, Izard, Kobak, Brown, & Smith, 2007; Mol & Bus, 2011; Morgan & Fuchs, 2007; Stanovich, 1986): Over the course of students' school career negative emotions about reading may accumulate as a result of negative experiences when students make attempts, at home or in school, to read longer stretches of text independently. This, in turn, may contribute to a decrease in reading motivation and reading frequency and thereby cause a setback in reading skills.

The finding that reading can become a source of threat, already in primary school, suggests that negative experiences already build up in primary education. To guarantee the occurrence of positive reading experiences, students may need guidance and support of their reading experiences for a much longer period than is currently offered during primary education (Snow & Moje, 2010). There are several examples of tutoring or curriculum programs that show the beneficial effects of guidance during reading on reading skill and motivation (e.g., Baker, Gersten, & Keating, 2000; Guthrie et al., 2004; Rimm-Kaufman, Kagan, & Byers, 1998). However, this type of support is generally very labor intensive and we may thus need to develop more efficient ways to support the ongoing reading process, to increase the likelihood that students enjoy reading and reach their educational potential. In the current era of electronic reading it may be useful to explore options like electronic support features embedded in digital reading materials (e.g., Meyer et al., 2010; Nielen, Smith, Sikkema-de Jong, Drobisz, van Horne, & Bus, under review).

The reading stimuli used in the attentional bias task included a variety of reading related pictures: the set included, apart from pictures of a single book, pictures of a full book case and pictures of children reading a book in various environments, alone or together with peers. This means that the bias toward reading does not include a specific setting, such as reading in school. A high average AB score indicates that reluctant readers have an attentional bias towards reading in general, independent of the setting in which reading takes place. When stimulating reading in this group of reluctant readers the general and easily applicable interventions, for instance providing them with a large and attractive book collection (e.g., Krashen, 2011), may not be sufficient to stimulate their reading.

Therefore we need experiments that test how negative emotions about reading can be altered. On the one hand digital reading materials with additional guidance provide

a promising avenue for future research. Another promising approach in the clinical and health psychology literature is attentional bias modification (ABM), a therapy used to reduce attentional bias when individuals suffer from anxiety disorders (e.g., Bar-Haim, 2010). ABM is based on the idea that anxiety can be reduced by training anxious individuals to focus on non-threat related stimuli. This type of therapy has proved effective for patients with generalized anxiety disorder (Amir, Beard, Burns, & Bomyea, 2009) and for patients with social anxiety (Schmidt, Richey, Buckner, & Timpano, 2009). ABM may also be useful to reduce the attentional bias toward reading, but so far there are no data to support this assumption.

Limitations and future directions

The comparison of a longer and shorter stimulus presentation in study 2 (500 ms vs. 1,500 ms) revealed that a presentation of the stimuli pairs of 500 ms was not long enough to associate the stimuli with reading, probably because of the complexity of pictures depicting a reading and matched neutral scene. Unexpectedly, the pictures in the original test displaying reading digital materials (e.g., a student reading on a tablet) did not relate to the reading attitude scales across the studies and were therefore excluded in the corrected data. Apparently, negative emotions about reading do not include electronic devices maybe because students this age rarely use new devices for reading.

One potential limitation of our study is the identification of reluctant readers. Avoidance of reading is the core characteristic of reading reluctancy and an extreme score on the title recognition list (zero or lower) seems a plausible way to trace down reluctant readers. The selection of reluctant readers, however, may be debatable and it might be interesting to select reluctant readers in different ways in future studies. We might for instance select within clinical groups such as pupils with the diagnosis dyslexia or low-literate adults.

Future studies should also try to address causal relations between an attentional bias toward reading and reading motivation, frequency and skill. We would expect reciprocal relations, just as the relation between reading motivation and reading skill (Mol & Bus, 2011; Morgan & Fuchs, 2007). It is also important to study to what extent an attentional bias may undermine the impact of reading promotion programs and training programs targeting low-literate adults. Furthermore, the finding that not all reading reluctant students show attentional bias might indicate that individual and/or environmental differences may have an impact on the development of attentional bias.

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Chapter 4

Enriched school libraries: a boost to academic achievement

Abstract

We compared students from schools with an enriched school library – a larger and more up-to-date book collection – with students from schools with a typical school library. We tested effects of an enriched school library on reading motivation, reading frequency, and academic skills. Fourth and fifth grade students of 14 schools with an enriched library (n = 272) were compared to fourth and fifth graders from 10 control schools (n = 411). Assignment to the experimental group was external and not determined by participants within schools, just as in randomized control trials. Students from schools with enriched libraries scored on average half a standard deviation higher on a standardized reading comprehension test than students from control schools. Mediation analysis revealed that for girls, this effect may have been obtained as a result of an increase in reading motivation and reading frequency. For boys, only reading frequency was a significant mediator.

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In the upper half of primary school, Dutch students' interest in reading longer stretches of text like in books begins to decline (Nielen & Bus, 2013) – a decline that continues after primary school. According to the outcomes of large scale PISA assessments, the decline in reading interest is a widespread phenomenon. The average percentage of fifteen-year old reluctant readers in all 65 countries participating in the PISA study is as high as 37%. In the Netherlands the number of reluctant readers is even higher; 49% of adolescents report not reading at all or hardly ever in leisure time (OECD, 2010). Many students seem to face what Moser and Morrison (1998) called 'aliteracy'. They have the ability to read but do not practice reading. In the end, this results in the same low reading performance as in cases of learning disabilities. There is an abundance of peer-reviewed studies stressing the importance of reading longer stretches of text such as books (and not websites or social media messages) on academic and professional success (e.g., Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; Mol & Bus, 2011; Taylor, 2013). It is therefore a challenge for schools to stimulate reading of books, not only in lower grades of primary education but thereafter, in higher grades of primary education and in secondary education, as well. In particular students' willingness to read and to put effort in reading difficult materials should be a matter of constant concern to teachers (Baker & Wigfield, 1999). Or as Trelease (1989, p. 205) stated: "Teaching children how to read is not enough, we must also teach them to want to read."

It is therefore important to evaluate tools that can be used to stimulate reading practice in schools, such as making books easily accessible by creating classroom libraries (e.g., Fractor, Woodruff, Martinez, & Teale, 1993). It would align with Krashen's theory that access to interesting material is a main tool to stimulate reading practice in schools (2011). The book collections in Dutch schools are often outdated and not likely to stimulate reading pleasure (Oberon, 2010). A nationwide program in the Netherlands, financially supported by the Dutch Ministry of Education and implemented by the Art of Reading (Kunst van Lezen), was initiated to improve the quality of school libraries and to thus promote greater interest in reading in children. This study is unique in that it tested the effects of an enriched school library, initiated by an external authority and not by the schools themselves, on students' academic performance.

Effects of an enriched school library on academic achievement

The availability of engaging reading materials may be the most powerful way to challenge reading reluctance and poor reading performance (e.g., Krashen, 2011).

There is some support for this in the literature: There is, for instance, evidence from a large-scale survey among students aged 8 to 16 in England that students use the school library more if it contains books that interest them and that users of the school library enjoy reading more (Clark, 2010). In the same vein, there are studies, albeit mainly correlational, corroborating positive relations between an enriched school library and students' reading performance (e.g., Francis, Lance, & Lietzau, 2010; Lance, 1999; Mullis, Martin, Foy, & Drucker, 2012; Scholastic, 2008). Only one study by Neuman (1999) in a much younger age group than our target group tested experimentally how providing high-quality children's books to child care centers in combination with a short training (10 hours) of the staff influences young children's literacy. After eight months, children from day care centers, where the books and training were provided, significantly outperformed children in comparable day care centers without the intervention on four out of six measures of early literacy development.

The current research tests the effect of an enlarged up-to-date book collection for students in the higher grades of primary education on reading motivation, reading frequency, and reading and mathematics proficiency. The intervention group was composed of schools participating in a nationwide project with the aim to enrich the school library. New books are added to the school library, resulting in a modern collection that contains at least five books per student (Oberon, 2011). To guarantee an attractive book collection over the years, each year 10% of the collection is renewed. For a fee (approximately 10 euro per student annually) employees of a local public library take care of the book collection in the participating schools and are available for four hours per week to assist students in selecting books that not only match their interest but also their reading level as matching of text complexity and students' ability seems important for students' reading development (Mesmer, Cunningham, & Hiebert, 2012; O'Connor et al., 2002). Schools with enriched libraries are responsible for scheduling daily time for free reading in the classroom and organizing book promotional activities such as the teacher reading to the students or book reviews presented by students or the teacher. We therefore expected that schools with an enriched school library not only would have more books available per student but would also spend more time reading during school hours than control schools.

Gender differences

There is an abundance of studies showing that girls are more motivated to read than boys, both in primary school (e.g., Logan & Johnston, 2009; McKenna, Kear, & Ellsworth, 1995; McGeown, Goodwin, Henderson, & Wright, 2012; Wigfield & Guthrie, 1997) and secondary school (OECD, 2010). In line with the difference in reading motivation, girls in the upper half of primary school read more than boys and their reading ability is on average higher (Logan & Johnston, 2009; OECD, 2010; OECD, 2013). Social explanations of gender differences in reading motivation are most evident. Leisure time reading is more valued by significant others as parents and teachers when it concerns girls (e.g., McGeown et al., 2012; Retelsdorf, Schwartz, & Asbrock, 2015). Furthermore, boys are strongly attracted to competing activities such as sports and gaming (e.g., Gentile, 2009; Hofferth & Sandberg, 2001) and may therefore have a more negative attitude toward reading than girls. It is also possible that their more advanced reading and language skills make reading less challenging for girls which might make reading a more rewarding activity for girls as compared to boys (e.g., Becker, McElvany, & Kortenbruck, 2010; Morgan & Fuchs, 2007). Due to the boys' reluctance to read, an enriched school library might have less impact on boys as compared to girls. In particular when the majority of books are narrative fiction (Peijen & Dessauvagie, 2013), the new collection might not be equally beneficial to boys and girls since boys seem to have a preference for non-fiction (Clark & Foster, 2005; Coles & Hall, 2002). To assess any gender differences in effects of an enriched school library, we analyzed effects for boys and girls separately.

Present study

In sum, the aim of this study was to test whether an enriched school library, with a large, modern book collection and more genres, affects academic skills and in particular reading skills. Schools were eligible for the experimental condition when an enriched library had been available for at least six months. We expected that any increase in academic skills, and in particular reading ability, due to an enriched library follows from an increase in reading motivation and time students spent reading self-selected books (reading frequency). Another aim was to assess whether the enriched library had a similar impact on boys and girls.

Summarizing, the aim of this study was threefold: (1) testing to what extent enrichment of the book collection in schools is a boost for academic skills development, in particular reading, (2) testing whether the students' reading motivation improves and reading frequency increases due to the enriched school library and whether these increases explain any effects of an enriched school library on academic achievement (Becker et al., 2010; Mol & Bus, 2011; Morgan & Fuchs, 2007), and (3) testing whether boys and girls benefit to the same extent from the enriched school library and whether in both groups academic skills improve as a result of increased motivation and more reading.

Method

Design

It was not possible to randomly allocate schools to the intervention or control condition. This would be problematic if the interest and willingness to invest in the school library in fact reflected a stronger reading culture prior to participating in the project. In other words, it would be difficult to ensure that schools with and without enriched school library are comparable and do not differ in other respects, and that any effects can be assigned to the enriched school library. We diminished this disadvantage of a quasi-experimental design by selecting experimental schools where, just as in randomized control trials, enrichment of the school library was an *exogenous* decision. We selected schools in which an enriched library has not been determined by participants – that is, the students, parents, teachers or administrators – within the schools. Instead, their placement in the treatment condition – an enriched school library – was determined externally by an independent agency. In this case, the city council had elected to make an enriched library at all schools in their city a priority and provided the required financial support to bedizen the school libraries. The intervention involved that the collection of books in school libraries was enlarged and 10% was renewed every year. A similar collection was available for all experimental schools including about 20% informational books. The collection contains an equal amount of books for grades 1 to 6. Schools received assistance from professional librarians in administering the school library. Participation in this school library project did not imply particular activities to facilitate increased engagement with books. It was up to the school staff to initiate such activities or not. There was no selection into the program as none of the schools in the city refused the offer from the city council. In other words, improvement of the school library was imposed on the schools in the experimental condition and was not a priority of staff and management of the schools themselves following from making language education a priority. As an enriched school library was an exogenous variable in the experimental group in this study, we were better able to test the causal impact of an enriched school library than in regular quasi-experimental studies (Murnane & Willett, 2011). As controls we recruited regular schools that were willing to participate in research but had, unlike the experimental schools, not received an exogenous incentive for an enriched school library and were not yet participating in the project.

Participants

Fourteen schools in the city where the council had made an enriched library a priority agreed to participate in this research. Twenty-one schools refused to participate for various reasons (e.g., too busy with other activities, too time consuming). After recruiting experimental schools we asked as control schools 20 regular schools from various cities who had not received an exogenous incentive for an enriched school library and were not yet participating in the school library project. Ten schools refused to participate for various reasons (e.g., too busy with other activities, illness of teachers). All participating schools were regular public schools, each following their own policy to obtain targets prescribed by the Dutch Ministry of Education, Culture and Science (2015) as is common in the Netherlands. There typically is large variation among schools in time spent on language education (M = 8.4 hours per week, SD = 3.0 hours; Meelissen et al., 2011) and the materials used to teach a topic. These differences are dependent on the preferences of the staff within a school and are only influenced by external agencies if schools participate in special programs or interventions. At the time of the research there were not such programs running in the experimental or control schools. In experimental schools an enriched library had been available for 14 months on average (SD = 6 months). Two of the control schools actually started to participate in the nationwide school library project in the two years after our study indicating that the schools in the control group were not different in the sense that they did not value the importance of reading education or were unwilling to invest in reading education. Participants in this experiment were fourth (n = 377) and fifth graders (n = 306), 272 from schools with an enriched school library (the experimental schools) and 411 from control schools (53% girls; M_{age} = 9.83, SD = .74).

Measures

School characteristics. To test whether the two groups of schools were comparable in language and literacy outcomes but differed on characteristics related to the intervention, we collected the following data about schools and curriculum:

Number of books per student. We asked teachers from all schools to estimate the number of books available in the school library, excluding study books, and the number of students. We calculated the total number of books available per student per school.

Reading frequency in the classroom. Teachers were asked to report how many minutes per week students spend on reading self-selected books in the classroom, which is a reflection of classroom practice and not of students' choice.

School evaluation by the Dutch Inspectorate of Education. The Dutch Inspectorate of Education is a government agency that evaluates school quality. Whereas the Dutch Inspectorate of Education does not evaluate the school curriculum, this agency does evaluate whether students achievement in language and literacy and other school topics is in line with what can be expected based on the schools' student population (The Dutch Inspectorate of Education, 2015). Schools are evaluated every four years and we have used the most recent publicly available report to assess whether student achievement in the experimental and control schools is at the expected level.

Average score on the final exam. We used the average score on the standardized test administered in the final grade, in 2010, the year before the intervention was implemented. This test includes spelling, reading comprehension, vocabulary, math, study skills, history, biology, science, and geography (van Boxtel, Engelen, & de Wijs, 2011; data retrieved from Ministry of Education, 2013). We assessed, on the basis of this test, whether the schools' academic level in the experimental and the control group was comparable prior to the intervention.

Percentage of students for which the school receives additional funding. Schools in the Netherlands receive additional funding for students if their parents have a low educational level. The percentage of students for whom schools receive additional funding is publicly available (Dienst Uitvoering Onderwijs [The Education Executive Agency of the Dutch Ministry of Education], 2014) and we used this percentage as an indicator of the socio-economic status of the school population.

Reading motivation. A reading motivation scale (Aarnoutse, 1990) was applied including 27 'yes' – 'no' questions like: "Do you think books are boring?" and "Do you read a lot at home?". Negative items (10) were recoded and a sum score was computed (maximum score is 27, α = .92). Higher scores reflected more enthusiasm for reading.

Reading frequency. A Title Recognition List was used to assess familiarity with books as a measure of reading frequency (Mol & Bus, 2011; Stanovich & West, 1989). The Title Recognition List follows a quick-probe logic in which a list of titles of popular books appropriate for the age level is presented. Participants check titles with which they are familiar without necessarily having read the book. Print exposure checklists tap into knowledge about books that can be obtained by reading books, but also by reading-related activities such as visiting libraries and bookstores. The way the list is assembled (only the very popular books are included) implies that the majority of these books are available in the libraries of both the experimental and control schools. To discourage participants from guessing the checklist also contained fake titles (i.e., foils). The checklist in this study contained the names of 26 real Dutch titles and 17

fake titles (α = .89). Percentage correct was calculated for the real titles and foils. The proportion of foils was subtracted from the proportion of real titles. Higher scores reflect more print exposure.

Reading comprehension. A standardized reading comprehension test (Cito Reading Comprehension; Feenstra, Kamphuis, Kleintjes, & Krom, 2010; Weekers, Groenen, Kleintjes, & Feenstra, 2011) was part of the assessment program in fourth and fifth grades of all participating schools. Based on individual test scores compared to national norms, pupils scored in one of the following five categories: 0 = lowest 10%, 1 = 15% well below average, 2 = 25% right below average, 3 = 25% right above average, and 4 = highest 25%. Since students were from different grades we preferred these standardized scores to raw scores.

Mathematics. A standardized mathematics test (Cito arithmetic and mathematics; Janssen, Verhelst, Engelen, & Scheltens, 2010) was administered as well. Students' mathematics scores were coded in the same way as the Reading Comprehension Scores. Since students were from different grades we preferred the standardized scores to raw scores.

Procedure

All students for whom parental consent was obtained (40% of students) were included in the study. We received more consent in the control group compared to the experimental group (47% versus 30%), probably because there were other studies running in the experimental group. The percentage of participating students was rather low not because parents objected to the study but because they forgot to return the consent form. Indicative is that only few parents (less than 2%) returned the consent form declining participation. For the 272 students from experimental schools for whom we obtained parental consent the students' parents received an email with a link to an online questionnaire and were instructed to let their children complete the questionnaires individually. The time it took students to fill in the questionnaire was registered by the program. Data for the control schools included the same questionnaires for reading motivation and reading frequency but were administered on paper during school hours. The session was supervised by trained research assistants or the first author. The standardized reading comprehension and mathematics tests were administered by the teachers as part of the progress monitoring system in both the experimental and the control schools. We obtained the test results from the teachers.

Finally, the low participation rate of students in both the experimental and the control group is a potential threat to the external validity of the study. Therefore we asked schools to provide anonymous reading comprehension scores of all fourth and fifth graders including the students who did not participate in the study. Five experimental (n = 250) and three control schools (n = 172) were able and willing to provide these scores. To gain insight in the external validity of our findings we compared the reading comprehension scores of the full student population of intervention and control schools.

Data analyses

Ten students missed reading motivation and reading frequency data because they were absent during the administration of questionnaires. Reading comprehension scores were missing for four students and mathematics scores for five students because these students' standardized tests were not administered. Students were included in the analyses if they had complete data for the specific analysis resulting in some variation in number of students across analyses.

Because students were grouped within schools, even a weak intraclass correlation can substantially deflate standard errors of regression coefficients. Therefore, regressing reading motivation, reading frequency, reading comprehension and mathematics on grade, gender, and the presence of an enriched school library , we preferred multilevel models to simple OLS. We first inspected the random effects of schools and, in so far as there were school-level effects, we tested whether some of the variation was attributable to the school library (Luke, 2004). In a next step, we entered the student-level covariates gender and grade. Reading motivation, reading frequency and reading skill were standardized prior to the analyses to enable a comparison of coefficients across outcome measures. As the parameter estimates show the effect of an independent variable in terms of the standard deviation of the dependent variable, they can be interpreted as effect sizes (e.g., Uchikoshi, 2005). We used a two level model (student, school) with only manifest (directly measured) variables. Reading motivation, reading frequency and academic skills were measured at the student level (level 1) whereas the enriched school library was measured at the school level (level 2). Following the Multilevel Structural Equation Modeling approach (Preacher, Zyphur, & Zang, 2010) we tested whether effects of an enriched school library on academic skills resulted from an increase in reading motivation and reading frequency using the Mplus software (version 7.31; Muthén & Muthén, 1998-2012). The effects of the enriched school library on reading motivation, reading frequency and academic

skills were tested at the school level, as were the indirect effects (e.g., the effect of the enriched school library on reading frequency via reading motivation). The effects of reading motivation and reading frequency on academic skills were tested at the student level (Preacher et al., 2010).

Results

To help in evaluating whether experimental and control schools were comparable, we compared the two sets of schools on the percentage of students for whom they received additional funding and the final exam scores of the schools. Due to small numbers and non-normal distributions, we used the nonparametric Mann-Whitney test for the comparisons on the school level. Results of the comparisons are displayed in Table 1. There were no differences in the percentage of pupils for whom the schools received additional funding, or in the final exam score in the years prior to the implementation of the enriched school library. According to the Dutch Inspectorate of Education, student achievement in language and literacy was insufficient in one experimental and two control schools, a nonsignificant difference between conditions (Fisher's Exact Test, p = .55). According to the teachers there were more books available per student in the schools with an enriched school library as compared to schools with an average library. There was a large variety in time spent on free reading. On average teachers did not report that students in the experimental schools spent more time on reading self-selected books in school than students in control schools.

Table 1. *Nonparametric tests of the difference between schools with and without enriched school library.*

	Enriched school library		No enriched school library			
	k	*Mdn*	*k*	*Mdn*	*U*	*p*
Percentage of students with additional funding	12	3.61	10	6.04	52.00	.63
Final exam scores	11	536.60	9	535.20	33.00	.23
Books available per student	14	5.72	9	4.22	30.00	.04
Time spent reading in school (min. per week)	14	75.00	9	75.00	60.50	.88

There were no differences between the experimental and control schools in terms of the distribution of students over grades (χ^2 = .42, p = .52), the proportion of boys and girls (χ^2 = 1.22, p = .27) or the students' age ($M_{experimental}$ = 9.89, SD = .77, $M_{control}$ = 9.79,

SD = .72; *t* (675) = -1.77, *p* = .08). However, the two conditions differed as expected in reading motivation, frequency of reading according to students' familiarity with books, and reading and mathematics skills, favoring students from schools with an enriched school library. See Table 2 for an overview. As indicator of the external validity of our findings we conducted a sensitivity analysis comparing all grade four and five students of five experimental and three control schools that were willing to provide anonymous reading comprehension data for students not participating in this study. In line with the results presented in Table 2 there was a significant difference between the full student populations of experimental (*n* = 250, *M* = 2.56, *SD* = 1.29) and control schools (*n* = 172, *M* = 2.24, *SD* = 1.31), *t*(420) = -2.48, *p* = .01, *d* = .25.

Table 2. *Overview of differences between students from schools with and without enriched school library.*

	Enriched school library		No enriched school library		
	M	*SD*	*M*	*SD*	*d*
Reading motivation	18.41	6.71	15.74	7.68	.37***
Familiarity with books	14.26	13.31	6.19	12.01	.64***
Reading comprehension	2.93	1.13	2.38	1.25	.46***
Mathematics	3.15	1.01	2.83	1.13	.30***

***$p < .001$

Inspecting bimodal correlations (see Table 3), we found low to moderate correlations between reading motivation and reading frequency (*r* = .18), between reading motivation and reading comprehension (*r* = .40), and between reading frequency and reading comprehension (*r* = .33). The performance in mathematics was strongly related to reading comprehension (*r* = .50) probably due to the narrative format of the mathematics problems in this test.

Table 3. *Bimodal correlations between all included variables.*

	1	2	3	4	5	6	7
1. Reading motivation	-						
2. Familiarity with books	.18***	-					
3. Reading comprehension	.40***	.33***	-				
4. Mathematics	.25***	.13**	.50***	-			
5. Gradea	-.05	.14***	.08*	-.06	-		
6. Gendera	.19***	.35***	.07	-.14***	-.02	-	
7. Enriched school librarya	.17**	.29***	.22***	.15**	.03	.04	-

[a] Spearman's rho was used for the dichotomous variables.
*$p < .05$. **$p < .01$. ***$p < .001$.

Multivariate analyses

In multivariate analyses, we tested effects of school library controlling for grade level and gender by regressing reading motivation, familiarity with books, reading achievement and mathematics on grade level, gender, enriched school library, interactions between school library and grade and interactions between school library and gender. For all outcome measures (i.e., reading motivation, familiarity with books, reading comprehension, and mathematics), inclusion of a random intercept for school resulted in a significant improvement of the model fit compared to the baseline model ($\chi^2 > .8.72$, $p < .001$). The variance explained by school characteristics equaled 11.5% (reading motivation), 19.5% (reading frequency), 10.0% (reading comprehension), and 5.5% (mathematics), thus emphasizing the need to use multilevel models in data analysis.

There were main effects for grade on familiarity with books and reading comprehension; for gender on reading motivation, reading frequency and mathematics; for the enriched school library on reading comprehension and for reading comprehension on mathematics. There were no interactions between grade and an enriched school library which we have therefore excluded from Table 4, but there were significant interactions between gender and an enriched library for reading motivation and familiarity with books. See Table 4 for the final models.

Table 4. *Regressing reading motivation, familiarity with books, reading comprehension, and mathematics on grade level, gender and the presence of an enriched school library.*

	Reading motivation	Familiarity with books	Reading comprehension	Mathematics
Grade	-.11	.34***	.16*	-.23***
Gender	.19*	.50***	.06	-.48***
Reading comprehension[a]	-	-	-	.56***
Enriched school library	.19	.50**	.41**	.06
Gender*school library	.37*	.35**	.15	.12

Note. Dependent variables were standardized.
[a] This variable was only entered in the model with mathematics as dependent measure to control for effect of reading performance on mathematics scores.
*$p < .05$. **$p < .01$. ***$p < .001$.

Grade had a significant effect on familiarity with books, reading comprehension and mathematics, meaning that students in grade 5 knew more book titles than students in grade 4 and had relatively higher scores on the norm scores of a standardized reading comprehension test and relatively lower scores according to norm scores

on the mathematics test. The tests are standardized for each grade separately so the effect of grade on the test scores is surprising. However, the lack of an interaction between grade and an enriched school library makes it unlikely that the main effect for grade would influence the effects of an enriched school library. Gender was significantly related to reading motivation and familiarity with book titles, indicating that girls were more motivated for reading and more enthusiastic readers than boys. Conversely, boys outperformed girls on the mathematics test. There was a main effect of an enriched school library on reading comprehension but not on the mathematics test meaning that, with an enriched library, students were better at reading but not at mathematics. As there was no interaction between school library and gender, effect sizes for girls (Estimate of fixed effect [Est.] = .53, p <.001) and boys (Est. = .43, p = .02) were similar (see Figure 1).

For motivation there was no main effect of the enriched school library but there was for familiarity with books. The significant interaction between gender and enriched school library for both reading motivation and familiarity with books indicates that an enriched library promoted motivation and familiarity with books more in girls than in boys. Testing effects of the enriched library for boys and girls separately, we

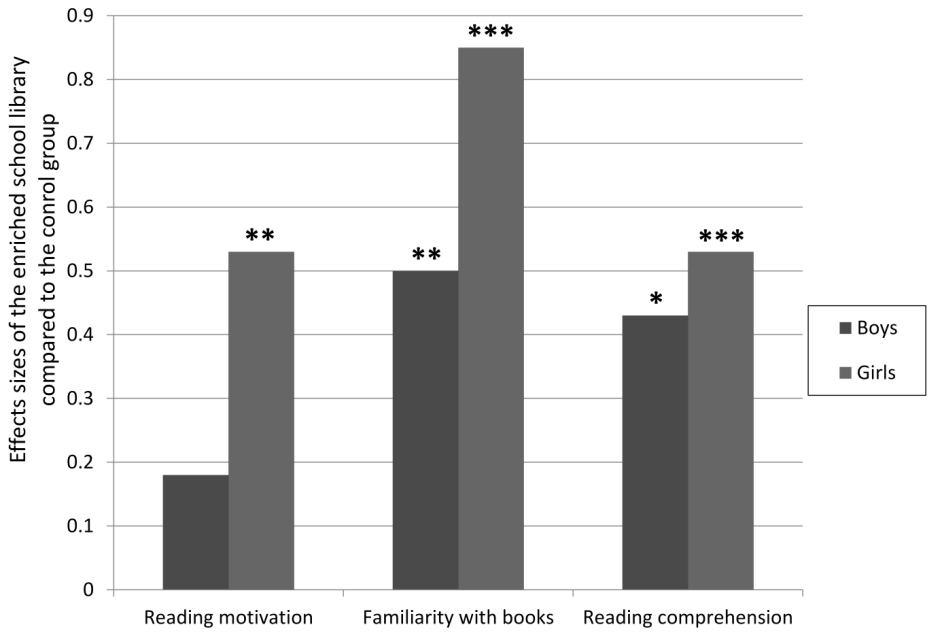

Figure 1. Effects of an enriched school library with the control group as baseline for boys and girls separately.
* p < .05. ** p < .01. *** p < .001.

found that, for girls, the enriched library was a moderately strong predictor of reading motivation (Est. = .53; p <.01) and a strong predictor of familiarity with books (Est. = .85; p < .001). This indicates that on both variables girls in schools with enriched school libraries scored over half a standard deviation higher than girls in schools without an enriched school library. For boys, there was a moderately strong effect of the enriched school library on familiarity with books (Est. = .50; p < .01), albeit smaller than the effect for girls, and no significant effect on reading motivation (Est. = .18; p = .28). The interaction between gender and an enriched school library for reading motivation and familiarity with books is shown in Figure 1.

Mediation analysis

We found support for a multilevel multiple mediation model for girls (see Figure 2). The effect of the enriched school library on reading comprehension was fully mediated by the effects of an enriched library on reading motivation and familiarity with books. Both indirect effects were significant: for familiarity with books the indirect effect was .22, with a 95% CI ranging from .13 to .31; for reading motivation the indirect effect was .17 with a 95% CI ranging from .08 to .27. In other words, the combined effect of motivation and familiarity with books fully mediated the effect of the enriched school library on the girls' reading performance. For boys, by contrast, there was a smaller indirect effect of familiarity with books (.12, 95% CI [.04 - .20]) and no effect of reading motivation (.06, 95% CI [-.05 - .16]); see Figure 3.

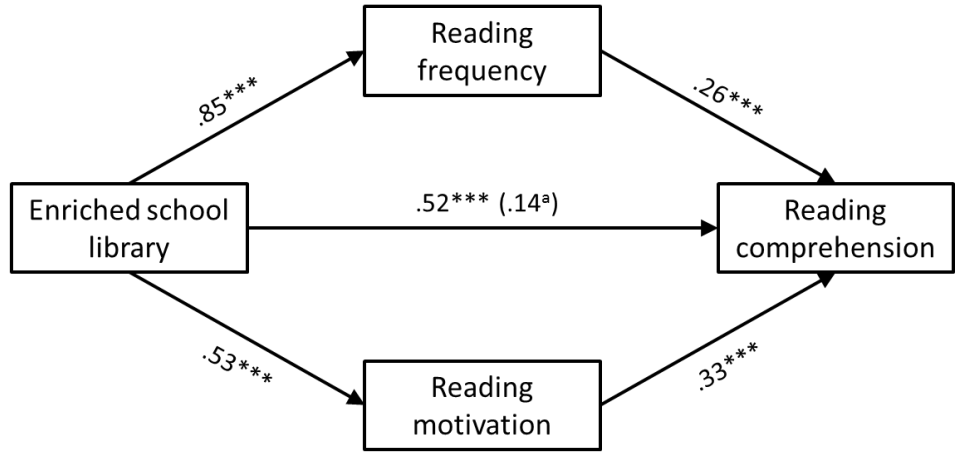

Figure 2. Results for girls. The relation between an enriched school library and reading comprehension was fully mediated by reading frequency and reading motivation.
*** p < .001. [a] p = .23.

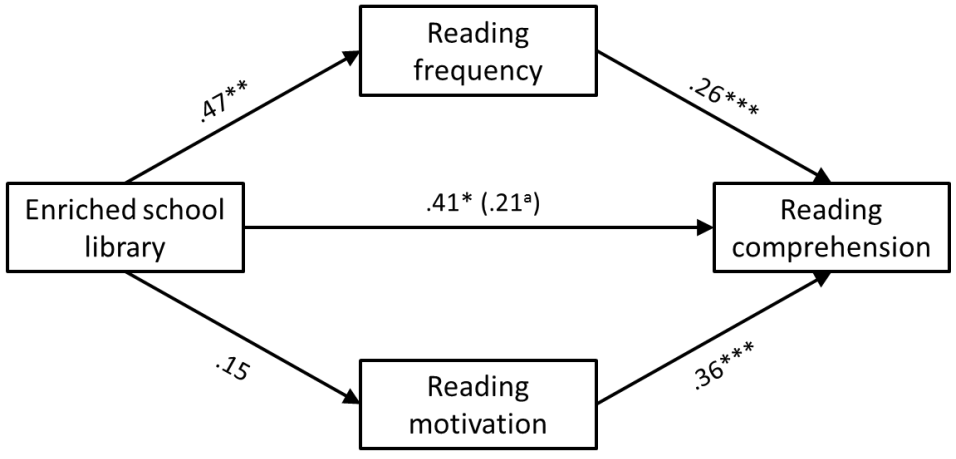

Figure 3. Results for boys. The relation between an enriched school library and reading comprehension was mediated by reading frequency but not by reading motivation.
* $p < .05$. ** $p < .01$. *** $p < .001$. ª $p = .12$.

Discussion

An enriched school library including more books per student as compared to regular school libraries seems beneficial for students' performance: students from schools with an enriched school library scored about half a standard deviation higher on a standardized reading comprehension test. That is, almost 70% of the students from schools with an enriched school library outperformed students from schools without an enriched library (Cohen, 1988). The enriched school library typically affected reading comprehension skills but not mathematics skills. Even though teachers from schools with an enriched library did not report more free reading than teachers from control schools, results of the Title Recognition Test indicate that there are differences in time spent on reading. Both boys and girls from schools with an enriched school library are more familiar with titles of age-appropriate fiction books indicating that they read more than students from control schools. Since enrichment of the school library in the experimental schools in the current study was determined externally by an independent agency - in this case not a researcher but the city council - it is plausible that the enriched school library is accountable for better reading results. It is unlikely that an overall stronger reading culture in the experimental schools motivating the adoption of an enriched school library resulted in better reading results.

We hypothesized that, due to an enriched school library, students' interest in reading improved and they read more, and, due to more practice, they became more

proficient readers (Becker et al., 2010; Mol & Bus, 2011; Morgan & Fuchs, 2007). For girls, data strongly aligned with this model. Reading interest and familiarity with books were full mediators between an enriched library and the girls' reading proficiency. As reading motivation and familiarity with books were each, controlling for the other variable, significant moderators we can exclude that these variables are manifestations of the same behavior.

For boys, data only partly aligned with this model. Due to an enriched school library, boys read more as appears from their familiarity with books, which had a positive effect on reading comprehension skill. Contrary to girls, however, they did not report being more motivated to read. In other words, they read more but the enriched school library did not make boys more enthusiastic about reading to the same extent as it made girls more enthusiastic. There may be several explanations for the finding that boys in experimental schools did not report to be more motivated for reading compared to boys in control schools. Boys may be aware that reading is less valued by significant others when it concerns boys and may therefore be less likely to respond affirmatively to questions such as "Do you like to read in your leisure time?" even though they had positive experiences with reading. It is also possible that boys are less inclined to respond positively to questions about their enthusiasm for reading because they may consider reading as a feminine activity (e.g., McGeown et al., 2012; Retelsdorf et al., 2015).

Given the correlational nature of the relation between reading interest, familiarity with books and reading proficiency we may also argue that reading comprehension mediates the relation between the enriched school library and reading frequency or that relations between reading motivation, reading frequency and reading comprehension are reciprocal (Mol & Bus, 2011; Morgan & Fuchs, 2007). Irrespective of which model fits best, our findings corroborate the theory that the availability of a large collection of attractive books is an important factor in stimulating an upward spiral of increasing motivation, reading frequency and comprehension (cf. Krashen, 2011).

Limitations and future directions

As any research not using randomized designs this study cannot provide conclusive causal evidence. However we were able to select experimental schools in which placement in the treatment condition was determined externally and not by participants – that is, the students, parents, teachers or administrators – within the schools. As the enriched school library was an exogenous variable and schools were apart from that comparable in language education findings may, despite the quasi-

experimental design, be taken as an indicator for the causal impact of an enriched school library (Murnane & Willett, 2011). Another limitation may be that a different procedure was followed in assessing reading motivation and reading frequency: In the experimental condition students filled in an online questionnaire at home while students in the control condition completed a printed version at school under supervision of the researchers. However, there is strong evidence that findings are comparable. First of all, the time it took students to fill in the online questionnaire at home was similar to the time it took students to fill in the questionnaires in the classroom. On average students spent 14.2 minutes (*SD* = 8.5 minutes) to fill in the reading motivation questionnaire and Title Recognition List at home which is about the same time as it took students in the control condition. Secondly, we did not find any relation between the time it took to fill in the Title Recognition Test and their score ($r = .02$, $p = .79$) as might be expected when students access external information (for example the internet) to complete the list.

An important question that remains relates to which elements of an enriched school library cause effects on students' reading proficiency. Is it the collection itself and its appeal to students or do effects depend on the activities that are elicited by an enriched school library? Although we tried to collect data about the impact of the enriched school library on the practices within schools we observed that the impact of the enriched library on activities in the school varies highly depending on preferences of the staff. We did, for instance, not find an overall effect of the enriched library on minutes per week to be spent on free reading. There were schools with enriched libraries in which students spent three hours per week reading self-selected books while in other schools with enriched libraries less than half an hour per week was reserved for the same activity. In informal discussions teachers reported activities to facilitate increased engagement with books (e.g., book presentations by the teacher, reading to the class, book reviews by students) but activities seemed to be very diverse across schools in the control and experimental condition. Based on these observations we may conclude that the enriched school library does not have a clear and consistent impact on the language curriculum. On the other hand, despite the similarity in free reading in the classroom as reported by teachers, students from experimental schools were more familiar with age-appropriate books as compared to students from control schools. This seems to indicate that students in schools with an enriched school library spent more time reading. In explanation of the inconsistency between teachers' reports and students' score on the title recognition test we may assume that students took more books home to read in leisure time. It is also possible

that the time for reading in school is the same but more productive in schools with an enriched school library because reading is more engaging as students can easily find interesting books. Studies using observational data collection methods may provide more insight in curricular differences that influence the reading development.

Conclusions

The final conclusion of the National Reading Panel (National Institute of Child Health and Human Development, 2000, p. 3.26) - "It would be difficult to interpret this collection of studies as representing clear evidence that encouraging students to read more actually improves reading achievement" – was controversial. Krashen, for instance, commented that free reading is at least as effective, and often better than, traditional instruction (Krashen, 2001). The present study is unique in that it tested whether an enriched school library, initiated by agents outside the schools, can support reading achievement. Our findings corroborate the conclusion that reading practice is vital: students from schools with an enriched school library are familiar with more book titles and have higher levels of reading achievement than students from schools without an enriched school library. The difference was approximately half a standard deviation in favor of schools with an enriched school library which is slightly below the effect sizes Krashen (2001) reports in response to the National Reading Panel ranging from .57 up till 1.01 for free reading interventions. On the other hand, effects of the enriched school library were stronger than the effects in studies that encourage reading by providing books to families during the summer holiday. Kim (2006), for instance, reported effect sizes ranging from .13 up till .22 and Allington and colleagues (2010) effect sizes ranging from .14 up till .21.

The present study provides support for the importance of a large and modern book collection. There is also evidence for the theory that such a collection raises interest in reading and boosts, mediated by greater interest, reading achievement. The collection may be the key element but we cannot exclude that other aspects are important as well, such as more opportunities for silent reading during school hours, book promotional activities or support from employees of the library in selecting books. Regardless of the actual underlying mechanisms, the enriched school library seems to have the potential to stimulate the reading development of students and may prevent that students become 'aliterate' (that is, being able to read but not motivated to do so). A library with a rich and varied collection is vital for students' reading proficiency and thereby for a successful academic and professional career of the students. In other words, school quality partly depends on the quality of the school library.

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Chapter 5

The effect of digital guidance on Fifth Graders' reading motivation and incidental vocabulary learning

Abstract

In this digital era, a fundamental challenge is to design additions to digital reading materials that help children improve their reading skills. Since reading books is challenging for many students in fifth grade, particularly for a minority genetically susceptible to attention problems, the researchers hypothesized that guidance from a digital Pedagogical Agent (PA) could improve students' reading motivation and incidental vocabulary learning. Using a sample of 147 fifth grade students, the researchers carried out a randomized control trial (RCT) with three groups of students reading: (1) hardcopy (print) books, (2) digital books without a PA, and (3) digital books with a PA. For the subsample of students with a genetic predisposition to attention problems, the PA condition resulted in significantly more incidental vocabulary learning. For the whole sample, there were no significant effects of the digitized texts or the PA.

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Although recreational reading is vital for reading skill development, a substantial proportion of students stop reading recreationally late in primary school (Nielen & Bus, 2013). As students loose interest in reading at this early age, their reading skill development levels off (Chall, 1983). Through independent reading students not only acquire an autonomous orthographic lexicon (Share, 2008), but also acquire new vocabulary and comprehension skills (Mol & Bus, 2011) - all necessary for continuation of reading growth. Without sufficient practice these skills remain underdeveloped and students experience a downward causal spiral of disinterest and decreasing time spent reading (Mol & Bus, 2011). A substantial proportion – about half of adolescents - reported that they almost never read for enjoyment (OECD, 2010). It is easy to predict serious consequences of what has been termed 'aliteracy' (Boorstin, 1984) – poor reading due to lack of practice - not only for individual students' academic and professional success (Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; Mol & Bus, 2011; Notten, 2011; OECD, 2010; Taylor, 2013), but also for society as a whole. There is a serious risk that an underclass of people with low literacy skills is emerging, people missing the literacy skills needed to function as full members in contemporary society, and in today's information-age 21st century economy (EU High Level Group of Experts on Literacy, 2012).

Kirschner, Sweller and Clark's (2006) argument that unguided or minimally guided instructional approaches are less effective than guided instruction may also apply to the domain of reading. For many students reading comes too early, as an activity that they feel compelled to practice without support. Especially when students fail to understand age-appropriate reading materials when unguided, reading may be frustrating and this may eventually result in withdrawal from reading. For optimal reading practice, after the initial stage of intensive reading instruction in elementary school, we need to find ways to guide students while reading text. In the current study the researchers explored the potential of a Pedagogical Agent (PA) in digitized books to provide encouragement to foster sustained effort during reading. The researchers modeled the PAs in the books on aspects of adult scaffolding that have proved to sustain reading of fiction, especially showing interest (Teale et al., 2013).

Guidance during reading

Effective adult tutors typically show interest in the book that the child is reading. See experimental evidence from so-called SMART (Start Making A Reader Today; Baker, Gersten, & Keating, 2000) and similar studies (e.g., Rimm-Kaufman, Kagan, & Beyers, 1998). Students in these experiments were individually tutored while reading

for one or two hours a week by trained volunteers who initiated discussion about the book's focal theme, what happened in the book and why, and any relationship of events, characters and situations in the book to the reader's personal life. Students also stay more motivated to read when they have a chance to discuss books with their parents (Nielen & Bus, 2013).

The main aim of the current study was to test whether technology-enhanced fiction books (PAs in books) can foster sustained independent reading, in the fifth grade, resulting in more learning from reading, particularly in incidental vocabulary learning. The researchers focused on this age group because these students are able to read independently, but still require practice to strengthen their reading skills. PAs added to digital fiction books may encourage students to continue reading. Since anthropomorphic characters with spoken, as opposed to written, feedback are most effective (e.g., Heidig & Clarebout, 2011; Lusk & Atkinson, 2007), the PA in the current study was designed as an animated, speaking mouse with anthropomorphic features in appearance and speech. Unlike other digital reading tutors, the PA did not teach specific strategies, such as summarizing and self-questioning or identification of main ideas, followed by elaborate feedback, as students try to apply the learned strategy (e.g., Meyer et al., 2010; Sung, Chang, & Huang, 2008; Mich, Pianta, & Mana, 2013). Instead our PA was modeled after the emotional support human tutors may provide by showing interest and how the story relates to students' personal experiences (e.g., Baker et al., 2000; Rimm-Kaufmann et al., 1998). The PA in the current study complemented the student upon having read each chapter. It summarized main events in the story ("We know now that Faiza is angry with her best friend"), and stimulated students to relate the content of the story to personal events in their own lives ("Have you ever had a fight with your best friend?").

Digital versus print reading

Although several studies have compared digital reading with print reading, in terms of reading motivation and reading comprehension, the results are somewhat contradictory. Because of distractions, checking emails or social media for instance (Daniel & Woody, 2013), and difficulties with navigation (e.g., scrolling and the lack of an overview of the entire text; Mangen, Walgermo, & Brønnick, 2013), digital reading materials may sometimes result in failure to understand the structure of the text, which in turn negatively impacts reading speed, reading comprehension and reading motivation. However, Taylor (2011) found no differences between digital and print reading on reading comprehension, suggesting that reading of digital text may

be at least as good as reading print. Some studies, suggest that reading of digital texts may also present certain advantages. Reluctant readers may actually prefer to read digital books, because digital reading provides the opportunity to read 'easy' books without their peers noticing (Miranda, Williams-Rossi, Johnson, & McKenzie, 2011). Digital reading may also attract reluctant readers who have negative experiences with traditional reading materials (Tveit & Mangen, 2014). To address the influence of the medium on reading, the researchers compared reading of print books with reading of digital books. As opposed to most prior studies (see Miranda et al., 2011 for an exception), students in the current experiment could choose from a larger collection of books, instead of fragments. They read complete storybooks, which is more authentic and more comparable to students' normal reading activities than the reading activities in previous studies.

Differential susceptibility to pedagogical guidance

Despite large differences in the quality of instruction in school, most students perform reasonably well in a variety of school environments, whatever guidance they receive (e.g., Pressley, 2006). For these students learning outcomes may depend less on the quality of guidance. Building on the evolutionary-inspired proposition that some students may be more strongly affected—both for better and for worse—by the guidance they receive, it is to be expected that some vulnerable children's performance may strongly depend on the quality of guidance (Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2007). In particular, genetic markers appear to be strong indicators for children's susceptibility to educational input (see for an overview Bakermans-Kranenburg & Van IJzendoorn, 2011; Van IJzendoorn & Bakermans-Kranenburg, 2015). Carriers of the long variant of dopamine-related genes, the DRD4 7repeat allele, are particularly responsive not just to qualities of the social-emotional environment, but also to the way learning is guided (Kegel, Bus, & Van IJzendoorn, 2011; Plak, Kegel, & Bus, 2015).

Electric signals in the prefrontal lobe (the part of the human brain that inhibits inappropriate impulses and emotions), monitoring impulses from the limbic system (the part of the brain that generates emotions), may be less efficient in carriers of the long variant of the DRD4 gene. Susceptible children may therefore be easily distracted and have more problems with staying attentive while solving problems (Kegel et al., 2011). The researchers hypothesize that intensive, closely monitored, and individualized guidance offered by technology-enhanced reading materials may, more than traditional reading materials, direct children's attention toward the task

at hand (keep them on task) and enhance their learning potential. In experiments with 4-year-old emergent readers, studies revealed evidence for the hypothesis that a genetically susceptible group benefited more from technology-enhanced materials than their peers. Carriers of the long variant of the DRD4 genotype benefited more from intensive, closely monitored, and individualized guidance of a computer program, as compared to their genetically less susceptible peers (Kegel et al., 2011; Plak et al., 2015). In other words, there is evidence showing that technology can turn a putative "risk" group into a successful group, when the program is enhanced with individualized guidance. In the same vein, the current study tested whether a PA providing the perception of intensive, closely monitored, and individualized guidance while reading fiction books supports learning in a genetically susceptible group.

Current study

This study focused on fifth grade students reading storybooks during eight hours spread over two months in three experimental conditions, comprised of reading: (1) regular print storybooks, (2) digital storybooks without PA, and (3) digital storybooks with a PA providing guidance during reading. In addition, the researchers accounted for a genetic susceptibility that might influence intervention outcomes. The researchers chose incidental vocabulary learning as an outcome measure to test the effects of reading on learning, assuming that new vocabulary is one of the significant learning effects of reading (Swanborn & de Glopper, 1999) and may be a sensitive measure for the effects of book reading (Mol & Bus, 2011). The researchers also assessed children's interest in reading as indicator for intervention effects.

The following questions were addressed:

1. Does the medium through which books are presented influence reading motivation and vocabulary learning?
   Digital reading may be more motivating for reluctant readers (e.g., Tveit & Mangen, 2014) but may also hamper learning of new vocabulary especially when the text is a hypertext (e.g., Daniel & Woody, 2013).
2. Can a PA providing guidance during reading help students to become more motivated to read and learn more new vocabulary from reading?
3. Can a PA providing guidance during reading help students, with a genetic disposition to attention problems, become more motivated to read and learn more new vocabulary from reading?

The researchers hypothesized that a PA can support susceptible students' reading, and that low-susceptible individuals would be less affected by a PA (cf. Kegel et al., 2011; Plak et al., 2015).

Method

Design

A schematic overview of the design and time course of the study is presented in Table 1. For reading ability, the researchers obtained the results of a standardized reading comprehension test administered by teachers in all participating schools prior to the study. Researchers pre-tested and post-tested reading motivation and vocabulary learning. During the eight week intervention, students independently read about one hour per week in the classroom or another location in the school in one of the three study conditions: (1) reading self-selected hardcopy (print) books, (2) reading self-selected digital books without guidance from a PA, and (3) reading self-selected digital books with guidance from a PA. No more than six students per classroom were included to avoid difficulties with the availability of computers required for digital reading. Because many parents refused to let their children participate in the study, due to the genotyping, there were less than six students available in some classrooms. In that case, the researchers selected three students to participate. In each classroom one or two students were randomly assigned to each condition. Buccal swabs were used to collect saliva for genotyping. After the study the saliva was analyzed to make a distinction between genetically susceptible and low-susceptible individuals.

Table 1 *Schematic overview of the design and time course of the experiment.*

Study phase	Time	Activities / tests (administered by)
Pretest	Week 1	- Reading ability (teacher) - Saliva collection for genotyping (researcher) - Reading motivation (researcher) - Vocabulary (researcher)
Intervention	Week 2-9, 8 hours in total	- 3 or 6 students per classroom - Randomly divided over three conditions, 1 or 2 students per condition - Condition 1: Reading hardcopy (print) books - Condition 2: Reading digital books without guidance - Condition 3: Reading digital books with PA guidance
Posttest	Week 10	- Reading motivation (researcher) - Vocabulary (researcher)

Participants

Twenty-eight fifth grade classrooms in 21 regular primary education schools across the Netherlands participated in this study. On average the researchers received informed consent for 30% of students approached. The number of students with

informed consent per classroom varied from four to 17. After the selection of three or six participants per classroom, and the exclusion of one participant who missed the posttest, 146 participants (M_{age} = 11.10 years, SD = .53, range: 10.17-12.92 years) remained, 76, or 52.1%, of which were girls

Materials

Books. Thirteen Dutch age-appropriate books were selected for inclusion in the digital reading conditions (see Appendix A for an overview of the books). The books differed in length (51-197 pages), difficulty, and genre including a mix for boys' interests (e.g., horror), girls' (e.g., horses) and unisex themes (e.g., history). Researchers avoided the selection of popular children's books, books high on bestseller lists and books used to create television series or films, but rather selected recently published books, to prevent student familiarity with the books. Prior to the intervention, students recognized an average of 1.47 out of 13 of the target books (*SD* = 1.79). Books were selected from three difficulty levels so students would not read books inappropriate for their reading level. Each book selection contained seven books. Classification was partly based on the book's length ('above average' M_{pages} = 141, 'average' M_{pages} = 100 and 'below average' M_{pages} = 89) and partly on the first author's estimate of the difficulty of the books' content. The two criteria were not always concordant. For instance based on length, a book might fall in the 'average' category, but based on the content - only short, single line sentences and a simple story structure - it was placed in the 'easy' category. The first author's estimate was used when the criteria were not concordant. Students were assigned to a difficulty level based on their score on a standardized reading comprehension test (Weekers, Groenen, Kleintjes, & Feenstra, 2011). Students scoring in the lowest 25% were assigned to the easy selection (n = 20), students scoring average were assigned to the average selection (n = 48), and students scoring in the upper 25% to the difficult books selection (n = 29).

Infrastructure for delivery of digital books. For the delivery of the digital versions of the books, the researchers used a web-based application called IMapBook (Smith, 2013; www.imapbook.org) that has been used in prior studies on reading and vocabulary learning (Smith et al., 2013). IMapBook provides convenient authoring of game-like interaction in web-based books, user logins, customized bookshelves, interface in a variety of languages (English, Dutch, Spanish, Chinese, etc.) and tracking of participants reading, interaction and game-play behavior in the web-based books. In the current study, IMapBook enabled the researchers (non-programmers) to create interactive digital versions of the 13 Dutch fiction books appropriate for

nine- to 11-years-olds. The text and illustrations in the digital books were exactly the same as in the print versions. The number of words on pages of books was adjusted to avoid the need for scrolling. Students in the digital reading conditions had access to their own personal bookshelf by logging into the IMapBook website. They saw only the selection of books at their appropriate reading level. The IMapBook database registered how much time each child spent reading per session, in total, and on which pages, as well as a record of their interactions with the PA.

Pedagogical Agent Guidance. The guidance in the Digital-PA condition was provided by an animated mouse (see Figure 1 for a screen shot of the PA) with accompanying pre-recorded sound fragments. The PA that students liked a lot was designed to encourage the perception of intensive, closely monitored, and individualized guidance. Guidance was book-specific and always provided at the end of a chapter, 11 to 15 times in each book (preferably 15 times, but less if the book contained less than 15 chapters). Each cycle had a duration of 25-60 seconds and included the following components:

1. The mouse complimented the reader, for example: "You finished another chapter, great job!"
2. The mouse summarized the key information in the chapter(s) the reader has just finished to support reading comprehension: "Faiza has had an argument with her best friend."

Figure 1. A screen shot showing the animated Pedagogical Agent used in the study. The guidance is presented in written as well as oral form.

3. The mouse asks a question to increase the reader's engagement in the story: "Have you ever had a fight with your best friend?"
4. The reader responds to the question by clicking on one of the multiple-choice options (e.g., 'yes' or 'no').
5. The mouse responds to the reader's answer and encourages the reader to continue reading: "Alright, let's read on to find out what Faiza will do to solve the problem." The mouse's responses were general statements to encourage the reader to continue reading.

Procedure

In each classroom all parents were asked for informed consent for both participating in the reading experiment and genotyping based on saliva. After the pretest was administered, the participants read books for eight hours, approximately one hour per week, for eight weeks. In the digital reading conditions, the progress was registered in a database that was only accessible by the researcher. This information enabled the researcher to check whether students spent sufficient time reading the books. Access to the digital reading program was blocked after students reached eight hours of reading. Once a week teachers received an overview of time spent reading per student. If students had not read at least one hour per week, the researcher called the teachers to suggest that students should read more. Teachers were also asked to urge the students in the print book control condition to read. Which books this group read and whether this group indeed spent the same time reading was difficult to monitor.

Pre- and posttests were administered by the first author and/or trained research assistants. The results were coded by Bachelor students, who had been instructed and trained appropriately, and who were blinded from the condition in which students had practiced reading. A random selection of 25% of the data was also coded by the first author. Intra-class correlation coefficients (ICC) for all measurement instruments was satisfactory; *r* equaled .98 (vocabulary measure) or higher.

Measurement instruments

Reading motivation. Participants were asked to rate 16 words and 24 pictures on a six point Likert-scale ranging from 0 for "very negative," to 5 for "very positive." The words were eight reading-related and eight neutral words matched on word length (see Appendix B) and familiar (e.g., 'book' and 'building') to fifth graders. The pictures were twelve depictions of everyday activities that were not expected to elicit strong emotions matched with twelve reading-related pictures (see Figure 2 for an example).

The criteria for matching reading-related and neutral images were the size and color of objects in each image. Pictures were also matched on the presence or absence of human faces and animals.

Figure 2. A reading picture (left) and a matched neutral picture (right) used in the picture evaluation task.

Alpha reliabilities for reading items and matched neutral items were .94 (pre- and posttest) and .85 (pre- and posttest), respectively. The researchers calculated difference scores by subtracting the average neutral score from the average reading score, as an indicator of reading motivation. Students with negative scores rated neutral items higher than reading items, indicating that they were not enthusiastic about reading. Students with positive scores rated reading items higher than neutral items, indicating a high reading motivation. The main advantage of this measure is that it does not explicitly asks students about their reading motivation. Instead, it is a more implicit measure that reduces the risk of socially desirable answering by the participants. The average of the neutral items provides an indication of how participants rate pictures and words in general. Comparing this average to the average rating of the reading-related pictures provides an indication of the participants' attitude towards reading. Meta-analytic findings have shown that, compared to typical students, rarely reading students score significantly lower on this task (Nielen et al., under review).

Vocabulary. Vocabulary learning was measured via a researcher-designed book-based word recognition checklist, using the yes/no test (Anderson & Freebody, 1983). This is a method to test receptive vocabulary knowledge using a list of difficult words from the target books to which the researchers added pseudo-words. Participants were explicitly told that the list contains pseudo-words and were asked to indicate for each word whether it is an existing word or not. The percentage of pseudo-words checked

by students was subtracted from the percentage of real words checked to correct for guessing. Higher percentage scores reflect higher levels of vocabulary. This yes/no test has previously been used in studies targeting first and second language learning (e.g., Mochida & Harrington, 2006) and is strongly related to reading comprehension (Anderson, Wilson, & Fielding, 1988). The alpha reliability of the word recognition checklist was satisfactory (pretest α = .93; posttest α = .95).

Five low-frequency words (e.g., 'miraculous', 'agitated') were selected from each of the 13 experimental books according to the following criteria: (1) a frequency below one occurrence per million words according to SUBTLEX-NL database (Keuleers, Brysbaert, & New, 2010), (2) the words appeared in the books, but not with more than a frequency of once per chapter, (3) the words did not occur more than twice in any one book. The researchers added 33 pseudo-words to this list as foils (e.g., 'howrelsers'), created by inserting low-frequency words from the target books (e.g., 'roddelpers'), not included in the checklist, into Wuggy, a multilingual pseudo-word generator (Keuleers & Brysbaert, 2010).

Reading ability. Students reading ability was assessed using a standardized reading comprehension test (Cito Reading Comprehension; Weekers et al., 2011) that was administered in all participating schools prior to this study. Reading ability scores were thus available only as a pretest measure. Students scored in one of the following five categories based on Dutch national norms: 0 = lowest 10%, 1 = 15% well below average, 2 = 25% right below average, 3 = 25% right above average, and 4 = highest 25%.

Genotyping. Based on the genotyping results, children were assigned to one of two groups: (1) a susceptible group with at least one DRD4 7-repeat allele (36%, n = 52) and (2) a low-susceptible group with no DRD4 7-repeat alleles (n = 94). The two genotypes were in Hardy-Weinberg equilibrium, χ^2 (1,146) = .06, p = .81.

Buccal swabs were collected from individuals to assess the DRD4 marker for differential susceptibility. The swabs were incubated in a lysis buffer (100 mM NaCl, 10 mM EDTA, 10 mM Tris pH 8, 0,1 mg/ml proteinase K, and 0,5% w/v SDS) until further processing. Genomic DNA was isolated using the Chemagic buccal swab kit on a Chemagen Module I workstation (Chemagen Biopolymer-Technologie AG, Baesweiler, Germany). The region of interest of the DRD4 gene was amplified by PCR using the following primers: a FAM-labeled primer 5'-GCGACTACGTGGTCTACTCG -3', and a reverse primer 5'- AGGACCCTCATGGCCTTG -3'. Typical PCR reactions contained between 10 and 100 ng genomic DNA template, 10 pmol of forward and reverse primer. PCR was carried out in the presence of a 7.5% DMSO, 5x buffer

supplied with the enzyme and with 1.25U of LongAmp *Taq* DNA Polymerase (NEB) in a total volume of 30 µl using the following cycling conditions: initial denaturation step of 10 min at 95°C, followed by 27 cycles of 30 sec 95°C, 30 sec 60°C, 60 sec 65°C and a final extension step of 10 min 65°C. One µl of PCR product was mixed with 0.3 µl LIZ-500 size standard (Applied Biosystems) and 11,7 µl formamide (Applied Biosystems) and run on a AB 3730 genetic analyser set up for fragment analyses with 50 cm capillaries. Results were analysed using GeneMarker software (Softgenetics).

Data analysis

To assess main effects of intervention conditions and susceptibility and the interaction of intervention conditions and susceptibility, the posttest scores on reading motivation and vocabulary were regressed on the pretest score on reading motivation and vocabulary, genetic susceptibility (DRD4 7-repeat allele absent versus present), and two contrasts: The first contrast, print versus digital, compared the hardcopy book reading condition with the two digital reading conditions (paper coded as -2, Digital-NoPA and Digital-PA coded as +1). The second contrast compared the Digital-NoPA with the Digital-PA group (Digital-NoPA coded as -1, paper book group coded as 0 and the Digital-PA group coded as +1).

Results

Intervention fidelity

Researchers asked students how they considered the difficulty level of their sets of books in the digital conditions. On a four-point scale, only a minority of students reported that the books were 'much too difficult' (2%) or 'much too easy' (17%). The remainder of the students reported the books were 'slightly too easy' (74%) or 'slightly too difficult' (7%), which validated the procedure used to assign students to the difficult, average or easy book collection, based on their reading ability scores.

The reading time, as registered in the online database, provided the opportunity to monitor whether students indeed read at least an hour per week. In seven of the classrooms, students read at least one hour per week without any encouragement from the researcher. In the other 21 classrooms, it was less common to read on a regular basis and researchers had to encourage teachers bi-weekly or weekly. Despite the regular encouragement, there were 40 children in the digital reading conditions (41%) who read less than 8 hours over 8 weeks (M = 7 hours and 16 minutes, SD

= 52 minutes). However, there were no differences between the average amount of time spent reading in the Digital-PA condition (M = 7 hours and 47 minutes, SD = 45 minutes) and the Digital-NoPA condition (M = 7 hours and 48 minutes, SD = 40 minutes), $t(95) = .07$, $p = .96$. Most students read approximately three books during the intervention. This meant that the students in the Digital-PA condition were encouraged by the PA approximately 45 times.

Missing data

For the word/picture evaluation task, there was 0.25% and 0.08% missing data for the pre- and posttest (respectively), and 0.35% and 0.35% for the vocabulary measure. Missing scores were imputed based on the non-missing scale items.

Validity of measurement instruments

To test the validity of our measurement instruments the researchers have examined the correlation between reading ability, reading motivation and vocabulary. Table 2 shows correlations for both pretest (reading ability, reading motivation and vocabulary) and posttest (reading motivation and vocabulary). Correlations between the three measures are moderate and correlations between the pre- and posttest of the motivation and vocabulary measure equal .77 and .79, respectively. This indicates a rather high test-retest stability.

Table 2 *Correlations between pre- and posttest measures.*

	1	2	3	4	5
1. Reading ability	-				
Pretest					
2. Vocabulary	.50	-			
3. Reading motivation	.29	.30	-		
Posttest					
4. Vocabulary	.48	.79	.31	-	
5. Reading motivation	.38	.35	.77	.37	-

Note. All correlations are significant at the $p < .01$ level.

Similarity of participants in the three conditions

Susceptible children (children with the DRD4 7-repeat allele) were equally distributed over the conditions, as shown in Table 3. Both susceptible and low-susceptible students were slightly more positive towards the reading pictures than the neutral

pictures on both the pre- and posttest. For the vocabulary test, they recognized about 35% (23 out of 65) of the difficult words on the pretest and 38% (25 out of 65) of the difficult words on the posttest. ANOVAs with condition (paper book reading, Digital-NoPA, Digital-PA) and susceptibility (DRD4 7-repeat allele absent versus present) as between-subject factors and pretest scores on motivation, reading ability and vocabulary as dependent variables did not reveal significant effects which indicates that the randomization was successful ($F < 1.40$, $ps > .25$).

Table 3 *Means (standard deviations) for the pre- and posttest reading motivation and vocabulary measure.*

		n	Reading motivation		Vocabulary	
			Pre	Post	Pre	Post
Paper	Susceptible	17	.36 (0.85)	.67 (0.78)	34.49 (15.85)	39.15 (18.81)
	Low-susc.	32	.43 (0.83)	.45 (1.01)	29.97 (16.82)	32.49 (15.99)
Digital-NoPA	Susceptible	17	.34 (1.00)	.46 (1.30)	34.46 (15.73)	34.65 (15.97)
	Low-susc.	31	.63 (1.20)	.76 (1.09)	36.60 (16.87)	39.86 (17.31)
Digital-PA	Susceptible	18	.64 (1.03)	.82 (1.03)	39.82 (17.33)	45.10 (17.50)
	Low-susc.	31	.57 (1.41)	.52 (1.04)	33.89 (13.80)	34.67 (15.35)

Effects of the intervention on motivation and vocabulary

The researchers regressed reading motivation and vocabulary learning on pretest scores, contrasts (print versus digital and Digital-NoPA versus Digital-PA), susceptibility (DRD4 7-repeat allele absent versus present) and the interactions between the contrasts and susceptibility. The regression models explained 61% (F (6, 139) = 36.06, $p < .001$) and 63% (F (6, 139) = 39.77, $p < .001$) of reading motivation and vocabulary post test scores, respectively; see Table 4.

Neither for reading motivation nor vocabulary learning did the print versus digital contrast cause a significant main effect, indicating that reading in a digital format was as effective for reading as the print (hardcopy) format. Also for the full sample, the researchers found no effects of the contrast between digital reading with and without PA, which suggests that the presence of a PA did not motivate the full sample of students to reading or enhance their vocabulary learning.

Based on non-significant interactions between the print versus digital reading contrast and susceptibility, print versus digital reading did not differentially influence motivation or vocabulary learning of the susceptible individuals. In other words, it did not make a difference to the susceptible individuals whether they read print (hardcopy) or digital texts. However, based on a significant interaction between the

Table 4 *Regression analyses examining the effects of the intervention on reading motivation and vocabulary learning accounting for the pretest and susceptibility.*

	B	*SD*	β	*t*	*p*
Reading motivation posttest					
Reading motivation pretest	.74	.05	.77	14.48	<.001
Print versus digital	.02	.05	.03	.46	.65
Digital-NoPA versus Digital-PA	-.10	.09	-.08	-1.15	.25
Susceptibility	.14	.12	.07	1.25	.22
Print versus digital*Susceptibility	-.06	.08	-.05	-.78	.44
Digital-NoPA versus Digital-PA*Susceptibility	.16	.14	.08	1.16	.25
Vocabulary posttest					
Vocabulary pretest	.81	.06	.77	14.71	<.001
Print versus digital	.17	.77	.01	.22	.83
Digital-NoPA versus Digital-PA	-1.50	1.33	-.07	-1.13	.26
Susceptibility	1.72	1.82	.05	.95	.35
Print versus digital*Susceptibility	-.64	1.28	-.03	-.50	.62
Digital-NoPA versus Digital-PA*Susceptibility	4.55	2.22	.13	2.05	**.04**

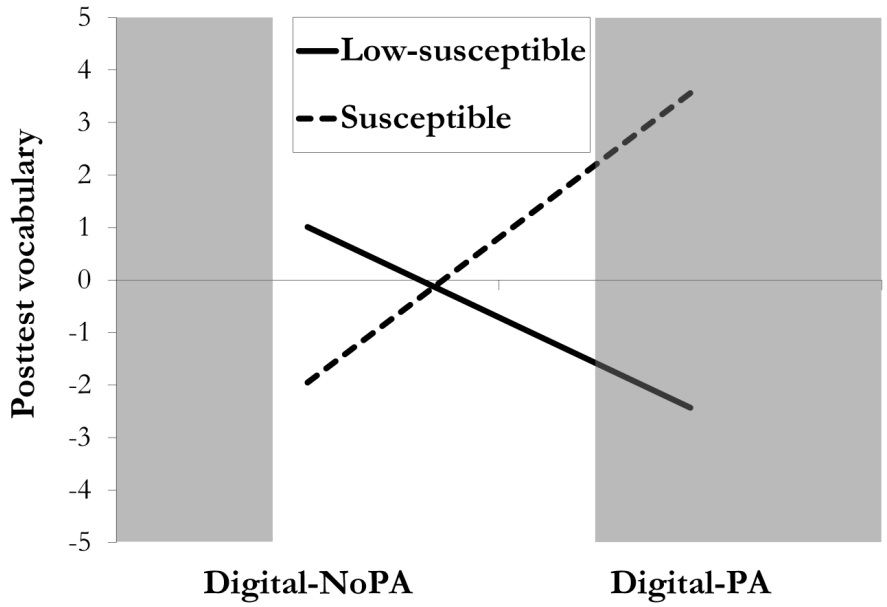

Figure 3. The interaction between the Digital-NoPA and Digital-PA contrast and susceptibility. The grey areas show the boundaries of a 95% CI around the crossover point (Widaman et al., 2012).

Digital-NoPA and Digital-PA contrast and susceptibility (see Figure 3), the presence of the PA did significantly improve vocabulary learning in the susceptible group (p one-sided = .04) with a large effect size (d = .69).

Characteristics of the interaction between susceptibility and feedback

Widaman and colleagues (2012) describe a procedure to test if an interaction is disordinal as may be expected when only part of the students benefit from the intervention. The susceptible group is expected to be responsive to the intervention while the low-susceptible group is not. Following Widaman's procedure, the researchers found that the crossover point (as displayed in Figure 3) was located about halfway between the dummy-coded conditions (-0.38; 95% CI: -1.25 - .49), which is typical for a disordinal interaction (Widaman et al., 2012). Because the lower bound of the confidence interval falls outside the range of the dummy-coded conditions the researchers cannot conclude that the interaction is disordinal in alternative samples as well. In two regression analyses, the researchers predicted the posttest vocabulary scores for the susceptible and low-susceptible children separately controlling for the pretest vocabulary scores. Feedback in the digital reading materials was a non-significant predictor for low-susceptible children (β = -.08, p = .26), explaining 0.6% of the variance in the posttest vocabulary scores. However, for susceptible children, feedback was a significant predictor (β = .13, one-sided p = .05) explaining 1.7% of the variance in the posttest vocabulary scores. This finding provides further evidence for the hypothesis that for the low-susceptible group the presence or absence of feedback did not influence learning whereas susceptible children did profit from the feedback during reading.

Discussion

The researchers found no support for the hypothesis that the medium (print versus digital) influences student reading motivation and reading comprehension (e.g., Daniel & Woody, 2013; Mangen et al., 2013; Miranda et al., 2011; Tveit & Mangen, 2014). The fifth graders in this study reading books in a digital format were not more motivated to read, nor did they learn more new vocabulary than their peers reading hardcopy print books.

The researchers did find support for the notion that students benefit from the presence of a pedagogical agent (e.g., Kegel et al., 2011; Plak et al., 2015). Especially the

susceptible subsample of students benefited from a PA. Susceptible students who read digital books with guidance from a PA learned more new vocabulary than susceptible children reading digital books without guidance. For low-susceptible students, in contrast, the presence of the PA did not result in more vocabulary learning.

Potential of digital reading

Studies comparing digital to print reading often focus on reading comprehension of short texts in an educational setting (e.g., Daniel & Woody, 2013; Mangen et al., 2013; Taylor, 2011). In this study the researchers took a different approach, where students were given the opportunity to choose their own reading materials and read digital texts over a longer period of time. Furthermore, in contrast to previous studies that measured whether students preferred print or digital reading (e.g., Tveit & Mangen, 2014), the researchers explored how digital reading influences the motivation towards reading in general. This may explain why the researchers did not find differences in reading motivation: if students *have* to read they may prefer to read digital texts. Reading digital texts, however, does not necessarily change their motivation to read, even if they have the opportunity to read entire books.

As digital reading is becoming more and more widespread (about 40% of Dutch adolescents and young adults occasionally read digital books; Witte & van Nood, 2014), it becomes vital to focus on how digital reading materials can be designed so that the materials support students during reading. In this study, the researchers tested whether a PA providing guidance during reading supports reading motivation and vocabulary learning. The PA did not have a main effect on the reading motivation and vocabulary learning when the researchers looked at the entire sample. However, the researchers also addressed the question whether the support is particularly effective for susceptible individuals (genetically disposed to attention problems). Based on the differential susceptibility notion - some individuals are more susceptible to quality of instruction than others – the researchers hypothesized that susceptible students would profit from the intervention whereas low-susceptible students would not. Through genotyping the researchers identified susceptible students - carriers of the DRD4 7-repeat allele (e.g., Kegel et al., 2011). Seemingly susceptible students were more sensitive to the encouragements from the PA than their low-susceptible peers. For the susceptible students guidance during reading had a moderately large effect on vocabulary learning (d = .69), whereas it had a non-significant negative effect (d = -.25) on the word learning for low-susceptible students. These findings are in line with the idea that susceptible children not only learn slower in absence of

guidance, but are more responsive to guidance as well. This study thus contributes to the accumulating evidence suggesting that children with the DRD4 7-repeat allele are more responsive to educational interventions with additional support (Kegel, et al., 2011; Plak et al., 2015); current findings extend previous findings in the field of emergent literacy to an older age group in need of reading practice. Further, this study suggests that for children with a genetic disposition for attention problems, carriers of the DRD4 7-repeat allele, even in the short term, PAs in digital books can significantly improve incidental vocabulary learning. One might anticipate even stronger effects with longer interventions.

For the other children, those without the DRD4 7-repeat allele and thus less sensitive to guidance, who actually did non-significantly worse on the vocabulary learning post-test in the PA condition than in the Non-PA condition (see Figure 3), perhaps a stronger and more challenging style of guidance, as opposed to the gentle and nurturing guidance that was effective for the susceptible students, might be better. On the other hand, challenging additions might distract the student from the story line because it implies another task thus affecting story comprehension negatively (cf. Bus, Takacs, & Kegel, 2015). In support of the latter it is worth mentioning that some students commented that they would rather read without the mouse. For interactive books to be effective for the full population, there might need to be adaptive individualization or differentiation but based on the current research it is unclear whether interaction and guidance can be formatted in a ways that it is profitable to all students.

Over the course of primary and secondary school many students stop reading (OECD, 2010) and thus fail to consolidate their reading skills. The reason for the discontinuation of reading may be that many students are expected to read independently too early in their development (Kirschner et al., 2006). Especially for struggling readers, who fail to understand age-appropriate reading materials, reading may become a frustrating activity and eventually students may start to avoid reading. To the best of our knowledge this is the first study demonstrating experimentally that guidance during digital reading can support students at the end of primary school, while reading self-selected fiction books. The significant results (for the susceptible children) strongly suggest the need for more research on interactive books for this age group (10-13 years old), especially also with guidance customized towards other segments of the population (i.e., non-susceptible).

The researchers did not find any evidence for changes in students' attitude towards reading in general after just eight hours of digital reading with guidance.

However, the reciprocal causal relationship between reading comprehension and reading motivation suggests that an appropriately differentiated intervention that supports reading comprehension may eventually support reading motivation as well (Becker, McElvany, & Kortenbruck, 2010; Morgan & Fuchs, 2007; Mol & Bus, 2011). The researchers therefore expect that, in the long run, guidance during reading may enhance the motivation to read as well.

Limitations

In this first study, with a PA supporting students during the reading of self-selected books in school, the researchers incorporated several elements of evidence-based practices with human tutors into the PA design. The PA praised the students, helped them to understand the story, related story elements to students' personal experiences and encouraged students to continue reading. A disadvantage of this extensive guidance is that it remains unclear whether a combination of these elements or a single element (e.g., praise) helps susceptible children to learn more from reading. Because it is unsure which elements of the PA cause the effects on reading comprehension it is difficult to deduce the type of support susceptible students miss when reading without PA. It is, however, likely that the susceptible students are easily distracted and become more stressed when a task is difficult (Kegel et al., 2011). Future studies may compare different types of feedback to assess what kind of support is most beneficial for susceptible students to focus on the reading and canalize feelings of stress.

The biochemical and behavioral mechanisms underlying the effect of feedback on susceptible students' vocabulary learning are not explicitly tested in the present study. A single gene cannot be responsible for protein and neurotransmitter production leading to learning (Kegel et al., 2011). The underlying mechanisms are not explored in the present study. Gaining more insight in these mechanisms may help unravel the underlying genetic pathway and biochemical processes that make carriers of the DRD4 7-repeat allele more susceptible to educational interventions providing individualized feedback. Ideally more easily observable characteristics, such as behavior and attitudes inferred from interactions with PAs, may be found that indicate whether or not individuals are susceptible (Plak et al., 2015). Despite these uncertainties an increasing number of studies indicates the usefulness of the DRD4 polymorphism to detect differential susceptibility, both in psychopathology and education (Van IJzendoorn & Bakermans-Kranenburg, 2015).

Conclusions

This study provides preliminary evidence for the potential of digital reading with PAs. Especially in the domain of independent reading of self-selected books, both in school and in leisure time, there seems much to win. This type of reading practice is important to develop literacy skills and thereby for educational attainment and professional success (Gottfried et al., 2015; Mol & Bus, 2011), but is generally considered to be the student's own responsibility. Some students manage to keep practicing and become skilled and enthusiastic readers. A large group of students, however, loses interest in reading over the course of primary and secondary education (e.g. OECD, 2010). This study shows that digital reading can provide new ways to continuously support the reading development, particularly for readers with a predisposition towards attention problems.

This study also shows that reading comprehension and motivation of fifth graders does not seem to be hampered by reading in a digital instead of a print format. Furthermore, accumulating evidence (Kegel et al., 2011; Plak et al., 2015) including the results presented in this article suggest that for a minority of children (carriers of the DRD4 7-repeat allele) learning outcomes are strongly dependent on the presence or absence of guidance. In the present study the researchers have shown that guidance provided by a PA helps susceptible students to learn more from reading. Although less susceptible students may adapt to a variety of learning environments without as large impact on their performance as students with attention problems, other styles of feedback in digital books might be explored for them, as the trends for discontinuation of recreational reading go well beyond students with genetic attention problems (OECD, 2010). As students' learning environment becomes increasingly digital, the opportunities to provide frequent, adaptive and individual feedback grow (Vasilyeva, 2007). More research into the characteristics that make digital reading programs effective, and for whom, should inform the design of evidence-based programs that help students to reach their full potential.

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Appendix A: Dutch children's books used in the experiment.

	Author	Title
1.	Nicolle Christiaanse	De Bleshof: Alles voor mijn paard
2.	Cornelia Funke	Ridder zonder hart
3.	Hans Hagen	Het hanengevecht
4.	Annet Jacobs	Het geheim van de dansende beer
5.	Netty van Kaathoven	Faiza is mijn held
6.	Mirjam Oldenhave	Control & copy
7.	Mirjam Oldenhave	Rampenkamp
8.	Hans Petermeijer	Potvis op het strand!
9.	Ruben Prins	Het geheim van de vergiftigde hond
10.	Daan Remmerts de Vries	Bernie King en de magische cirkels
11.	Lydia Rood	Marietje Appelgat
12.	Jacques Vriens	Strijd om de kathedraal
13.	Anna Woltz	De pizza spion

Appendix B: Words in the word/picture evaluation task (Dutch translation).

	Reading words	Matched neutral words
1.	book (boek)	door (deur)
2.	cover (kaft)	flat (vlak)
3.	read (lezen)	kettle (ketel)
4.	title (title)	next to (naast)
5.	comic strip (strip)	wagon (wagen)
6.	letter (letter)	building (gebouw)
7.	page (pagina)	finger (vinger)
8.	story (verhaal)	headlight (koplamp)

Chapter 6

General discussion

Even though most students seem to be enthusiastic readers in the early years of primary school, the motivation to read often declines late in primary school. As is demonstrated in Chapter 2 for a large sample of 7- to 13-year-old students, the reading motivation of the majority of students declines in the upper half of primary school, which implies a risk for what Boorstin (1984) called *aliteracy*: Students can read but, due to lack of practice, their skills remain underdeveloped. Reading proficiency may be an explanation for why some people end up in a downward causal spiral of disinterest and decreasing time spent reading. The interest shown by good readers remains stable or even increases whereas the reading interest of poor and average readers declines. This indicates that independent reading is (too) taxing, even for a group of average readers, and may take away their pleasure in reading. Because the time spent reading declines in poor and average readers but not in good readers, the gap in reading proficiency is likely to widen late in primary education as a result of a decline in reading interest.

We also studied students' emotions about reading as another potential factor in a downward causal spiral of disinterest and decreasing time spent reading. Due to an accumulation of negative reading experiences, students may acquire negative emotions about reading. The experiments in Chapter 3 reveal evidence of anxiety about reading. Similar to individuals with an anxiety disorder - being scared of crowded places or elevators for instance – some students suffer from anxiety about reading and show a positive attention bias towards pictures depicting books or people reading. Students suffering from anxiety about reading appeared to have low scores on title recognition lists, indicating that they indeed avoid reading. Findings thus support the hypothesis that anxiety about reading is likely to contribute to a loss of interest in reading, in the end resulting in less reading practice and skill development. Anxiety about reading is rather common in secondary education, in particular among low performing students. It affects only a minority late in primary school and in pre-academic secondary education but affects the majority of students in pre-vocational secondary education – generally the least proficient readers (cf. Kordes, Bolsinova, Limpens, & Stolwijk, 2013).

Environmental factors influencing whether students experience a downward spiral

Students' interest in reading declines late in primary school in particular when parents do not show interest in their child's reading. If parents do get involved in their child's reading and discuss books with them, motivation remains quite stable or

even increases over time (see Chapter 2). Unfortunately, about 40% of the parents do not take an interest in their child's reading by initiating conversations about books. From other research appeared that with regard to teachers it is not common for them to guide their students when they are selecting books for independent reading or engaging in free voluntary reading in school, even though guidance helps to keep students engaged in reading (Reutzel, Jones, Fawson, & Smith, 2008). In other words, many students do not receive guidance during free reading, neither at home nor in school. Altogether it is usually the students' individual responsibility as to whether they succeed in engaging in recreational reading.

Chapter 4 reported on an experiment that tested whether reading materials make a difference for interest in reading, frequency of reading, and reading proficiency. To that end, students from schools with a typical school library were compared to students from schools with an enriched school library that contained an up-to-date collection of children's books. Enriched libraries also contained more books than the common school libraries; on average two books more per student. The outcomes of this experiment support Krashen's (2011) claim that free voluntary reading as is promoted by an up-to-date collection of children's books is 'the most powerful tool in language education'. Students from schools with an enriched school library were better readers than students from schools without an enriched school library. Their score on a standardized reading test was about half a standard deviation higher. Students from schools with a an enriched collection of books have more interest in reading and know more book titles, which may explain why students from schools with an enriched school library are more proficient readers.

The potential of digital reading

Digital reading is becoming more and more common and programs that offer digital reading materials have several advantages. Firstly, programs with digitized books usually provide access to a large number of books, generally many more than are available in typical school libraries. An example of a program widely used in schools in the United States is Lightsail, which offers access to more than 80,000 books for students aged 4 to 16. Since access to a large collection of books seems to help students to remain interested in reading and develop their reading skill, such programs may be a great asset. Digital programs can keep track of a student's reading performance and make suggestions for further reading based on what seems to interest the student, just like Amazon recommends materials based on previous purchases. Students may thus easily find new interesting reading materials. However we did not find that digital

reading is advantageous compared to reading hardcopy print books or, vice versa that print books are preferable to digital books. Findings in Chapter 5 show that reading self-selected digital books did not affect students' motivation nor did it affect learning new vocabulary from reading, thus suggesting that reading digital books is as effective as reading print books.

In Chapter 5 we examined the potential of digital guidance on students' motivation and their ability to learn from reading. A built-in Pedagogical Agent (PA) praised the students, helped them to comprehend the text, related the book content to the students' own experiences and encouraged them to continue reading - all activities that are known to guide students' reading. The experiment reported in Chapter 5 provides evidence for the hypothesis that guidance by a PA embedded in digital reading materials can be helpful for students. A PA was especially beneficial for students who are susceptible to the environment (carriers of the DRD4 7-repeat allele). Because of their presumed high reactivity to the environment, carriers of the DRD4 7-repeat allele may easily shut themselves off from immersive reading experiences due to numerous distractions present in the direct environment. We found that particularly this susceptible group benefits from external support during reading. When a PA succeeds in focusing these students' attention on the story content, these students show increased learning and even outperform their less susceptible peers.

How to stimulate reading?

Preserving students' initial enthusiasm for reading is important to prevent students experiencing a downward causal spiral of disinterest and decreasing time spent reading. Prevention of aliteracy – the outcome of ending up in a downward spiral - is vital, not only for the students themselves but also for society at large. On the basis of the results of the studies in this dissertation we recommend:

1. **Give students access to a large and modern book collection.** Students from schools with an enriched school library read more frequently and are better readers than students from schools without an enriched school library. Access to a large collection of attractive books seems vital in the promotion of reading even though the precise mechanisms that explain the effects of an enriched school library are as yet unknown. There may be a direct effect of the larger book collection on student's interest in reading or an indirect effect when teachers from schools with an enriched school library initiate more reading activities. This prospect may come within reach of all Dutch schools when digital programs like the American program Lightsail would be available for the Dutch market.

2. **Provide students with daily opportunities for free voluntary reading.** Students' reading may be stimulated if they are allowed to read self-selected books in school every day and bring home the books from the school library. It should be noted that in some Dutch primary schools the time scheduled for the reading of self-selected books does not exceed 25 minutes per week.
3. **Circumvent the 'inoculation fallacy' and continue to provide guidance during reading after students have learned to read independently.** It is a misconception, called the 'inoculation fallacy' by Snow and Moje (2010), that high-quality reading instruction limited to the early grades of primary school is sufficient for students to stay enthusiastic readers. Many students need guidance to continue, even in more advanced stages of reading development at the end of primary school and in secondary school, for example through the regular initiation of discussions about the book that the student is reading. This guidance is required to enable sustained effort and engagement while practicing reading.
4. **In interventions against illiteracy emotional resistance should be taken into account.** In 2015 the Dutch ministry presented a new language policy in which the prevention and reduction of illiteracy is the core component (Bussemaker, Asscher, Klijnsma, & van Rijn, 2015). Several interventions are funded by the ministry to prevent illiteracy in childhood and adolescence and provide interventions for illiterate adults. Many illiterate individuals are likely to have an emotional resistance towards reading due to an accumulation of negative experiences with reading. Future studies should address how negative emotions about reading can be reduced most effectively and whether this approach supports the development of literacy skills in illiterate individuals.
5. **Build personalized guidance into digital books.** Our findings provide evidence for the efficacy of guidance by a Pedagogical Agent embedded in digital fiction books. We need more research to determine if, and how, a Pedagogical Agent can be effective and for which students in particular. It is important to test how digital materials can support students before digital reading becomes the standard in education. A more adventurous approach of Dutch publishers, in close collaboration with researchers and funding agencies, would be helpful.

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Nederlandse samenvatting (Dutch summary)

Aanvankelijk zijn de meeste kinderen enthousiaste lezers, maar uit de eerste studie in dit proefschrift blijkt dat al aan het eind van de basisschool de leesmotivatie terugloopt. Dit brengt het risico van ageletterdheid met zich mee, een term die voor het eerst door Boorstin (1984), de toenmalige directeur van de nationale Amerikaanse bibliotheek, is gebruikt: kinderen kunnen wel lezen, maar doen het niet. Door gebrek aan oefening stagneert de ontwikkeling van leesvaardigheden en daarmee plezier in lezen.

Weerstand tegen lezen

Negatieve ervaringen met lezen dragen er wellicht aan bij dat kinderen hun interesse in lezen verliezen. Je beleeft geen plezier aan lezen als veel van de inhoud van een boek je ontgaat en je maar zelden een boek helemaal uitleest. De tweede studie bevestigt de hypothese dat leerlingen lezen mijden als gevolg van angst, zoals mensen met sociale angst liever geen presentatie geven voor een grote groep (bijv. Beidel & Alfana, 2011; Kase & Ledley, 2007; Kerig & Wenar, 2006). Kern van onze taak om leesweerstand te meten is dat een van de twee plaatjes die tegelijkertijd op het scherm worden aangeboden, het object van angst representeert. Wie ergens bang voor is zal de aandacht juist daarop richten. Als iemand bang is voor spinnen en op een van de plaatjes een spin staat, trekt dat plaatje bij personen met een spinnenfobie de meeste aandacht. Als angst voor lezen bestaat, is te verwachten dat bij personen met leesangst het leesplaatje de meeste aandacht trekt. Dit was het geval: De aandacht van *niet-lezers* werd meer door leesplaatjes dan neutrale plaatjes getrokken. In de groep *lezers* vonden we daarentegen geen verschil in aandacht voor leesplaatjes en neutrale plaatjes. Dit resultaat wijst op angst voor lezen in de groep niet-lezers. De leesweerstand komt veel voor in het middelbaar onderwijs, met name in het vmbo waar in de regel ook de minst vaardige lezers zitten (zie bijvoorbeeld Kordes, Bolsinova, Limpens, & Stolwijk, 2013).

Factoren die de leesmotivatie en leesvaardigheid beïnvloeden

In de derde studie is getest of de beschikbaarheid van leesmateriaal verschil maakt voor leesmotivatie, leesfrequentie en leesvaardigheid. Met dit doel zijn leerlingen van scholen die niet meedoen aan het project de Bibliotheek *op school*, vergeleken met leerlingen van scholen die wel meedoen. Scholen die meedoen aan de Bibliotheek *op school* hebben een uitgebreide en moderne boekcollectie tot hun beschikking; gemiddeld bevat de collectie twee boeken per leerling meer dan gewone schoolbibliotheken.

Het was niet mogelijk scholen willekeurig aan beide condities toe te wijzen zoals een gerandomiseerd experiment vereist. Het grote bezwaar van een quasi-experimenteel design - scholen kiezen zelf voor een interventie en zijn daarom misschien sowieso al meer geïnteresseerd in leesbevordering dan scholen die niet meedoen – is afgezwakt door alleen experimentele scholen te laten meedoen waar, net als in een gerandomiseerd experiment, deelname aan het project een exogene beslissing was. Deelname aan de Bibliotheek *op school* was niet de keuze van betrokkenen (leerlingen, ouders, leerkrachten of schoolleiding) maar van een onafhankelijke instantie, in dit geval de gemeenteraad, die een verrijkte schoolbibliotheek als prioriteit stelde in haar gemeente en scholen daarvoor extra financiële steun gaf.

Leesvaardigheid ging sterk vooruit onder invloed van Bibliotheek *op school*. Het verschil tussen leerlingen van scholen met en zonder Bibliotheek *op school* was meer dan een halve standaarddeviatie. Dit effect komt tot stand doordat kinderen meer gaan lezen onder invloed van Bibliotheek *op school.* Wat betreft leesmotivatie zijn de bevindingen minder eenduidig. Bij meisjes heeft Bibliotheek *op school* ook invloed via een verhoogde leesmotivatie maar bij jongens vonden we daarvoor geen aanwijzingen.

De mogelijkheden van digitaal lezen

Digitaal lezen wordt steeds gebruikelijker en programma's voor digitaal lezen hebben verschillende voordelen. Ten eerste bieden deze programma's vaak toegang tot een groot arsenaal aan boeken, meer dan er normaal gesproken beschikbaar zijn in een schoolbibliotheek. Ten tweede bieden digitale programma's de mogelijkheid om nieuwe suggesties te doen voor leesmateriaal dat de kinderen aanspreekt en leerlingen te begeleiden tijdens lezen. Uit onderzoeken is gebleken dat een tutor, een volwassene die kinderen intensief begeleidt bij het lezen, positieve effecten heeft op de leesvaardigheid van kinderen; zie bijvoorbeeld onze bevinding in Hoofdstuk 2 dat praten met de ouders over boeken lijkt te helpen (zie ook Baker, Gersten, & Keating, 2000; Rimm-Kaufman, Kagan, & Beyers, 1998).

Een gerandomiseerd experiment leverde geen verschillen in leesmotivatie of woordenschat op als we papieren boeken vergeleken met digitale boeken. Wel bleek een ingebouwde tutor invloed te hebben op een deel van de leerlingen. Deze tutor complimenteerde de leerlingen, hielp ze om de tekst goed te begrijpen, legde het verband tussen het verhaal dat ze aan het lezen waren en hun eigen ervaringen en moedigde ze aan om verder te lezen – allemaal activiteiten waarvan bekend is dat ze leerlingen kunnen helpen met lezen. De resultaten van dit experiment ondersteunen de hypothese dat een tutor ingebouwd in digitaal leesmateriaal leerlingen kan helpen

bij het lezen. De tutor was met name effectief voor leerlingen die heel gevoelig zijn voor de omgeving (dragers van het DRD4 7-repeat allel). Vanwege hun gevoeligheid voor de omgeving zijn deze kinderen wellicht sneller afgeleid tijdens het lezen. De tutor zorgde ervoor dat ze toch hun aandacht bij het verhaal hielden. Deze leerlingen leerden daardoor meer woorden tijdens het lezen en deden het zelfs beter dan leerlingen die minder gevoelig waren voor de omgeving.

Aanbevelingen

Het is belangrijk om het initiële enthousiasme voor lezen te behouden. Voorkomen moet worden dat kinderen in een negatieve spiraal terecht komen waarin hun leesmotivatie terugloopt waardoor ze minder lezen, hun leesvaardigheid achter raakt en hun motivatie vermindert. Het voorkomen van ageletterdheid - de uitkomst van deze negatieve spiraal - is cruciaal voor maatschappelijk succes. Op basis van de studies in dit proefschrift kunnen de volgende aanbevelingen gedaan worden:

1. Geef kinderen toegang tot een grote en moderne boekcollectie.
2. Zorg ervoor dat kinderen dagelijks zelfstandig lezen.
3. Ga er niet vanuit dat een aantal jaren van goed leesonderwijs aan het begin van de basisschool voldoende zijn om leesproblemen op lange termijn te voorkomen (de 'inoculation fallacy') en blijf kinderen ondersteunen bij het zelfstandig lezen, ook in de hogere leerjaren van de basisschool en daarna.
4. In de leesbevordering moet rekening gehouden worden met weerstand tegen lezen waardoor leerlingen lezen niet alleen actief vermijden maar ook meer moeite hebben om zich op lezen te concentreren.
5. Exploreer de mogelijkheden van digitaal leesmateriaal om leerlingen tijdens het lezen te begeleiden.

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Curriculum Vitae

Thijs Nielen was born on October 14, 1989 in Heemskerk, the Netherlands. After completion of his secondary education at the Jac. P. Thijsse College in Castricum (2005) he studied Education and Child studies at Leiden University, specializing in Learning Problems and Impairments. After obtaining his bachelor degree in 2010 he started the research master, Developmental Psychopathology in Education and Child Studies, which he finished in 2012. In April of the same year he started his PhD research at the institute of Education and Child studies at Leiden University examining potential causes of and solutions for aliteracy. From September 2015 he works at the Ministry of Education, Culture and Science.

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