Aliteracy : causes and solutions

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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).

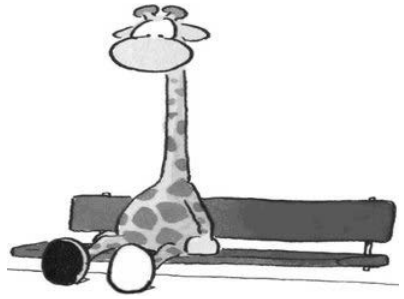
Picture pairs	
A. Reading pictures studies 1-3	Neutral pictures studies 1-3
	
	
B. Reading pictures study 4	Neutral pictures study 4
	
	

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).

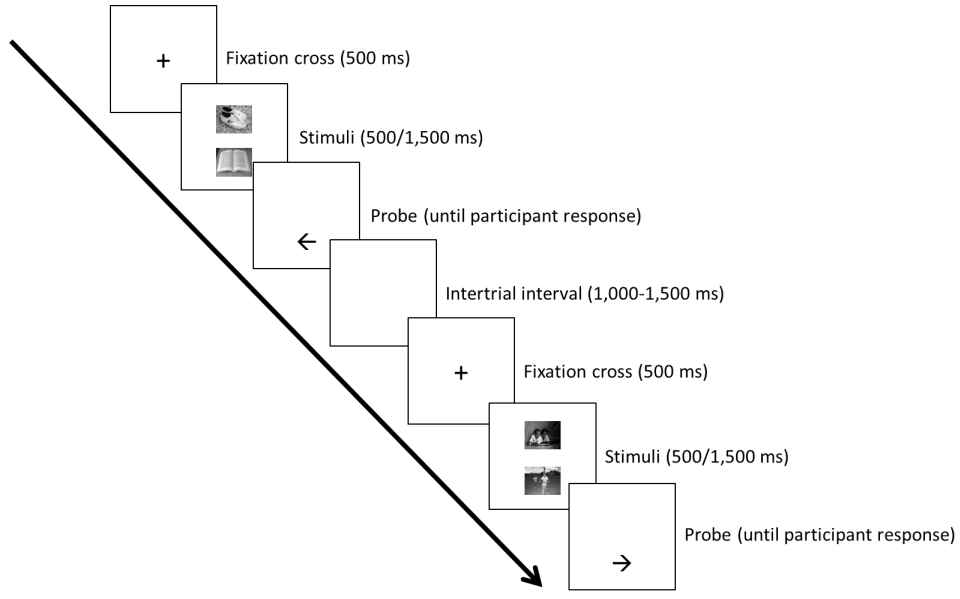


Figure 2. Two exemplary trials of the visual dot-probe task. In the first example the probe (arrow pointing left) appeared in the position of the reading picture and in the second (arrow pointing right) in the position of the neutral picture. Each trial started with a fixation cross (duration 500 ms) 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).

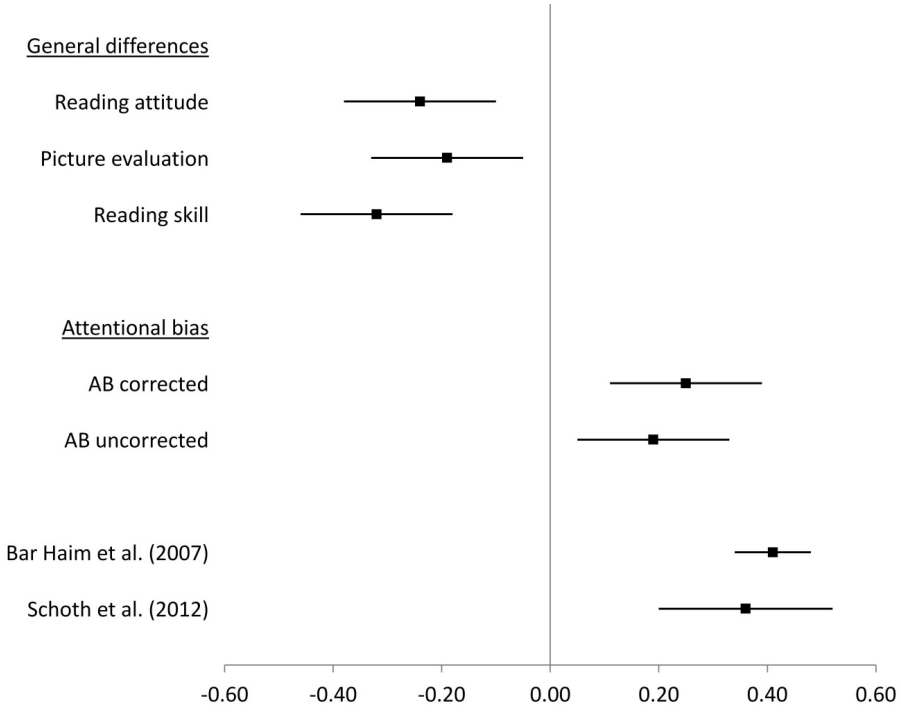


Figure 3. Meta-analytical differences between RR and RE students on general features (reading attitude, picture evaluation and reading skill) and AB scores; for comparison of effect sizes we added the combined AB effect for stress disorders (Bar-Haim et al., 2007) and chronic pain (Schoth et al., 2012).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