The Relationship Between Children's Reading Ability and Emotional Health

Deanna Francis, B Psychology (Honours)

Department of Cognitive Science

ARC Centre of Excellence in Cognition and its Disorders

Reading Research Group

Faculty of Human Sciences

Macquarie University, Sydney, Australia

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Thesis Summary

The emotional health of poor readers is a relatively new area of research. Despite considerable effort, our understanding of the emotional health outcomes for poor readers remains unclear, and the theoretical underpinnings of this association are not well understood. Against this background, the overarching aim of this thesis was to improve our understanding of the relationship between poor reading and poor emotional health. To this end, I conducted two studies to explore the potential relationships between children's poor reading and emotional health.

The first study in this dissertation presents a systematic review of the research examining the association between poor reading and anxiety, and poor reading and depression. The second study is an empirical study to examine the associations that exist between different types of poor reading and different types of emotional health.

The findings from this dissertation suggest a reliable association between poor reading and anxiety. We also found that different aspects of reading were related to different types of reading self-concept, and that poor readers were at greater risk for poor perceived reading competence and poor reading attitudes. We also found that reading comprehension was related to anxiety and depression, and that poor readers were at higher risk for experiencing anxiety and depression.

Considered together, these findings support the general idea that poor reading is associated with poor emotional health, and the more specific idea that some types of poor reading are reliably associated with some types of poor emotional health but not others. We provide suggestions for how this field of research might move forward to support the needs of poor readers with poor emotional health.

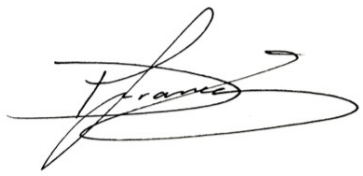
Statement

I, Deanna Francis, certify that the work in this thesis entitled "The relationship between children's reading ability and emotional health" has not previously been submitted for a degree, nor has it been submitted as part of requirements for a degree to any other university or institution other than Macquarie University.

I also certify that this thesis is an original piece of research and it has been written by me. Any help and assistance that I have received in my research work and the preparation of the thesis itself has been appropriately acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis. The research presented in this thesis was approved by the Macquarie University Ethics Review Committee, reference numbers: **5201500286** on 11th June 2015.

Signed:



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Chapter 1

General Introduction

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Introduction

Poor reading

Reading is a complex task that some children fail to master despite receiving adequate instruction. Approximately 16% of children experience reading difficulty, and a further 5% experience profound and persistent reading problems (Ramus, 2001). These reading difficulties include problems with learning to read using the letter-sound rules (phonological decoding), using memory to recognise whole words (irregular reading), and understanding the meaning of text (reading comprehension; Brunsdon, Hannan, Coltheart, & Nickels, 2002; Castles & Coltheart, 1993; Castles et al., 2009; Coltheart, Masterson, Byng, Prior, & Riddoch, 1983; Nation, Cocksey, Taylor, & Bishop, 2010).

Written English is comprised of two types of words: regular words, which can be read accurately using the letter-sound rules (e.g., DROP), and irregular words that cannot be read using the letter-sound rules (e.g., YACHT). According to most cognitive models of reading, reading these two types of words depends on different combinations of cognitive processes. For example, according to the dual-route model of reading words aloud, the presentation of a regular or irregular word triggers the processing of the identity and order of letters. The output of this processing activates cognitive processes in two "routes": a sublexical route that translates letters or letter clusters (graphemes) into sounds (phonemes), and a lexical route that translates a whole written word into a spoken word. The output of both of these routes activates processes in a phonological output system that produces a spoken word (Castles & Coltheart, 1993; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001).

An impairment in any cognitive process in either route of the dual-route model of reading can result in poor reading. For instance, an impaired sublexical route may result in poor nonword reading, which is a specific problem with reading words that follow the letter-sound rules. An impaired lexical route may result in poor irregular word reading, which is a specific problem with recognizing whole-words from orthographic memory. Impairments in both the sublexical and lexical routes may result in poor nonword and irregular word reading, which is characterized by problems with reading words via the letter-sound rules and via whole word recognition (i.e., poor nonword and irregular reading; Coltheart et al., 1983; Castles & Coltheart, 1993, 1996; Goulandris & Snowling, 1991; Snowling & Hulme, 1989; Temple, 1997; Temple & Marshall, 1983).

As well as having significant difficulties learning to read, many children with poor reading have problems learning to spell. Spelling in English also involves learning regular (e.g., DROP) and irregular (e.g., YACHT) words. According to the dual route model, spelling regular words involves the sublexical route where phoneme (sound) to grapheme (letter) rules are applied. Spelling irregular words involves the lexical route where whole-word orthographic information is retrieved and recognized, as well as its associated meaning. The written form of the word is then retrieved from the orthographic output lexicon and the process of writing occurs via the graphemic output buffer (Ellis & Young, 1988; Patterson, 1986). Research to date suggests that damage to the sublexical route specifically leads to poor nonword spelling, and damage to the lexical route specifically leads to poor irregular word spelling (Behrmann & Bub, 1992; Campbell & Butterworth, 1985; Hanley, Hastie & Kay, 1992; Temple, 1985).

The "side effects" of poor reading

Unfortunately, the effects of poor reading on a child's life are not restricted to reading and spelling alone. Research suggests that poor reading may have a negative

impact on a number of areas of a child's development. Arguably, the most well-researched area is poor readers general academic achievement. Numerous studies have found an association between poor reading and poor academic achievement, or that poor readers experience lower achievement outcomes compared to typical readers (Hakkarainen, Holopainen, & Savolainen, 2013; Kiuru, Haverinen, Salmela-Aro, Nurmi, Savolainen, & Holopainen, 2011; Maughan 1995; Savolainen, Ahonen, Aro, Tolvanen, & Holopainen, 2008; Spreen, 1987). Studies also suggest that children with learning disabilities are more likely to leave school early and have poorer academic outcomes than their typical achieving peers (Murray, Goldstein, Nourse, & Edgar, 2000; Fairweather & Shaver, 1991; Levine & Nourse, 1998).

Another aspect of a child's development that might be negatively affected by poor reading is their attention. Research suggests that around 15- 40% of poor readers have clinically significant attention problems (Hinshaw, 1992; Semrud-Clikeman, Biderman, Sprich-Buckminster, Lehman, Faraone, & Norman, 1992). In line with this prevalence, numerous studies have found an association between poor reading and poor attention, or that poor readers show poorer attention than controls (Dykman & Ackerman, 1991; Goldston et al., 2007; Levy, Young, Bennett, Martin & Hay, 2013; Semrud-Clikeman et al., 1992; Willcutt & Pennington, 2000; Willcutt, Pennington & DeFries, 2000). Interestingly, the association between poor reading and poor attention appears to be more reliable for symptoms of inattention than symptoms of hyperactivity or impulsivity (Michelini, Eley, Gregory, & McAdams, 2015; Willcutt et al., 2000).

Yet another area of a child's life that might be impacted by their poor reading is their social life. Many studies have found that poor readers show antisocial or disruptive behavior (Maughan, Pickles, Hagell, Rutter, & Yule, 1996; McIntosh, Reinke, Kelm, & Sadler, 2012; Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006; Williams &

McGee, 1994); feel disappointed, ashamed, and embarrassed about their reading ability compared to their peers (Riddick, 1996); show poorer social skills than their typical reading peers (Parhiala et al., 2014); and are bullied and teased by their classmates (Humphrey, 2002; Ingesson, 2007; Riddick, 1996; Singer, 2005). Similar findings have been reported by studies of children with learning disabilities, who have been found to experience poor social skills, peer rejection, and victimization compared to their typical achieving peers (Kavale & Forness, 1996; Kuhne & Wiener, 2000; Mishna, 2003).

The effect of poor reading on emotional health

Given the evidence that poor reading is associated with poor academic achievement, poor attention, and a difficult social life, it is perhaps not surprising that hypotheses have been proposed for associations between poor reading and poor emotional health (Maughan & Carroll, 2006). To date, most studies of this association have focused on measuring reading self-concept, anxiety, or depression in poor readers (Chapman & Tunmer, 1997; Grills-Taquechel et al., 2014; Mammarella et al., 2014). For instance, reading self-concept refers to the beliefs and perceptions an individual holds about their reading performance, irrespective of their actual reading ability. For instance, a negative reading self-concept suggests that an individual holds negative beliefs about the reading ability (i.e., “I’m terrible at reading” or “I will never be a good reader”), while a positive reading self-concept suggests that an individual holds positive beliefs about their reading ability (i.e., “I’m good at reading stories” or “I enjoy reading to the class”). These self-perceptions, beliefs and emotional evaluations about one’s reading ability influences how an individual feels about their reading, and thus may subsequently influence their likelihood to practice reading in the future.

The results of these studies have been somewhat mixed. For instance, some studies report poor reading self-concept for poor readers (Chapman & Tunmer, 1995, 1997; Chapman, Tunmer, & Prochnow, 2000; Retelsdorf, Koller, & Moller, 2011, 2014) while others report mixed results (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Forster & Souvignier, 2014) or high reading self-concept for poor readers (Fives et al., 2014). Likewise, some studies report anxiety and depression for poor readers (e.g., Arnold et al., 2005; Bonifacci, Montuschi, Lami, & Snowling, 2014; Carroll, Maughan, Goodman, & Meltzer, 2005; Carroll & Illes, 2006; Grills-Taquechel, Fletcher, Vaughn, & Stuebing, 2012, 2013; Goldston et al., 2007; Mammarella et al., 2014; Morgan, Farkas, & Wu, 2012; Nelson & Gregg, 2013; Undheim, 2003; Willcutt & Pennington, 2000) while others report no difference in anxiety or depression between poor readers and controls (e.g., Bonifacci et al., 2014; Carroll et al., 2005; Boetsch, Green, & Pennington 1996; Miller, Hynd, & Miller 2005; Nelson & Gregg, 2012; Undheim, 2003).

As well as facing the challenge of mixed empirical evidence for an association between poor reading and reading self-concept, anxiety, or depression, researchers interested in the emotional health of poor readers are faced with a scarcity of theory. At this point in time, there appear to be three general hypotheses about the causal mechanisms that might be responsible for an association between poor reading and poor emotional health. First, poor reading could cause poor emotional health primarily by social comparisons and negative reading experiences that trigger emotional reactions (Calsyn & Kenny, 1997; Fleming, Cook, & Stone, 2002; Kellam, Rebok, Mayer, Ialongo, & Kalodner, 1998; Morgan & Fuchs, 2007). For example, studies have shown that poor achievers compare their performance to their high achieving peers, which leads poor achievers to show negative self-evaluations and thus negative self-concept (Moller & Pohlmann, 2010; Moller, Pohlmann, Koller, Marsh, 2009). Further, a reading treatment

study has demonstrated that improving children's reading achievement resulted in fewer symptoms of depression compared to children who did not show reading improvement (Kellam et al., 1994).

Second, poor emotional health may cause poor reading because of poor task engagement and reduced motivation to practice reading (Briggs, 1987; Bryan, Sonnefeld, Gabowski, 1983; Culler & Holahan, 1980; Elliot & McGregor, 1999; Marsh & Yeung, 1997). Studies suggest that children with poor self-concept (Chapman & Tunmer, 1997), anxiety (Arnold et al., 2005; Carroll et al., 2005; Grills-Taquechel et al., 2013; Mammarella et al., 2014; Nelson et al., 2013), or depression (Willcutt & Pennington, 2000; Maughan et al., 2003; Carroll et al., 2005; Daniel et al., 2005; Morgan et al., 2012; Mammarella et al., 2014) avoid reading because of their poor emotional health. This limits their opportunity to practice reading skills and reduces the likelihood of improving their reading ability.

Third, an association may exist between poor reading and poor emotional health because of a reciprocal relationship between poor reading and poor emotional health (Chapman & Tunmer, 1997; Grills-Taquechel et al., 2012; Retelsdorf et al., 2014). While this "reciprocal" hypothesis appears to be the most likely explanation, only two studies, to our knowledge, have directly examined the bidirectional relationship between poor reading and poor emotional health. One study found reading self-concept predicts children's likelihood to practice reading, that their reading performance is then compared to their peers, which in turn influences their self-concept, beliefs, and engagement (Retelsdorf et al., 2014). A second study found that poor readers with anxiety may be unable to cope with their difficulty learning to read, which leads them to avoid reading, reduces the likelihood of improvement, and maintains their anxiety (Grills-Taquechel et al., 2012).

In sum, poor reading can have a number of negative side effects on a child's life, including their emotional health. To date, there is some evidence to suggest that there may be an association between poor reading and certain types of poor emotional health, such as poor reading self-concept, anxiety, and depression. However, the strength of this evidence is moderated by mixed findings between studies, and by a lack of clear theories about why associations may exist between poor reading and poor emotional health.

Outline of Studies

The overarching aim of this dissertation was to improve our understanding of the relationship between poor reading and poor emotional health. To this end, I conducted two studies. In Study 1, I conducted a systematic review to determine what rigorous research studies have revealed about the relationship between poor reading and anxiety and depression. In Study 2, I conducted an empirical study to examine the relationship between different types of poor reading and different types of reading self-concept, anxiety, and depression. Below, the aims and methods of each of these studies are summarized.

Study 1: The relationship between poor reading and anxiety and depression: A systematic review

As previously mentioned, there appears to be inconsistent evidence regarding a potential association between poor reading and anxiety, and poor reading and depression. The aim of Study 1 was to better understand the extent and source of this inconsistency (or consistency) by identifying and evaluating existing well-designed studies that have examined the association between poor reading and anxiety, and poor reading and depression. The outcomes were used to determine whether the studies reviewed support a reliable association between poor reading and either anxiety or depression, and if this was

found to be the case, what characterized the subgroup of poor readers experiencing poor emotional health outcomes.

Study 2: The relationship between poor reading and poor emotional health

The overarching aim of Study 2 was to further improve our understanding of the relationships between poor reading and different types of emotional health. The specific aims of this study were to examine the relationships between different types of poor reading and different types of reading self-concept, anxiety, and depression in poor readers. The study assessed 29 children aged 8- to 12-years on different measures of reading and spelling (nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of emotional health including reading self-concept (perceived reading difficulty, perceived reading competence, reading attitudes), anxiety, and depression. The outcomes were used to determine if statistically reliable relationships existed between certain types of poor reading and certain types of poor emotional health within poor readers, and if so, whether poor readers were at higher risk of those emotional health problems.

Summary

In sum, the overarching aim of this dissertation is to extend our understanding of the nature of the association that may exist between poor reading and poor emotional health. The following two chapters present two studies that examined the association between children's reading and emotional health. Because this dissertation uses a "thesis by publication" format, the chapters included in this dissertation contain some unavoidable overlap, but all attempts have been made to minimise this repetition. This dissertation concludes with a general discussion that summarizes the main findings of each study, and considers the limitations, theoretical implications, and practical applications of the outcomes of this research.

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Chapter 2

The Association between Poor Reading, Anxiety, and Depression: A Systematic Review

Deanna **Francis**, Genevieve **McArthur**, Nathan **Caruana**, & Jennifer **Hudson**

Macquarie University

Abstract

The aim of this systematic review was to determine (1) whether anxiety or depression are reliably associated with poor reading, and (2) what characterizes poor readers who suffer from anxiety or depression. The review identified 17 relevant articles: 14 examining the association between poor reading and anxiety, and 12 examining the association between poor reading and depression. We found a reliable association between poor reading and symptoms of generalized anxiety, separation anxiety, and trait anxiety. There was no clear evidence for an association between poor reading and symptoms of depression. We also found a suggestion in the data that the association between poor reading and anxiety may be more reliably observed among males with poor reading. We suggest numerous ways in which this field of research might move forward to better understand the association between poor reading and anxiety and depression in children.

The Association between Poor Reading, Anxiety, and Depression: A Systematic Review

Introduction

Sixteen per cent of primary school children have reading skills that fall below the average range for their age (i.e., more than one standard deviation below the age mean), and five per cent of children have significant, severe, and persistent reading impairments (Ramus, 2001). These reading impairments include difficulties with phonological decoding (i.e., the ability to read words via association between letters and speech sounds), wholeword or sight-word reading (i.e., the ability to recognize whole words from memory), and reading comprehension (i.e., the ability to understand the meaning of written text; Brunsdon, Hannan, Coltheart, & Nickels, 2002; Castles & Coltheart, 1993; Castles et al., 2009; Coltheart, Masterson, Byng, Prior, & Riddoch, 1983; Nation, Cocksey, Taylor, & Bishop, 2010).

We have known for quite some time that poor reading is reliably associated with lower academic achievement outcomes (Hakkarainen, Holopainen, & Savolainen, 2013; Kiuru, Haverinen, Salmela-Aro, Nurmi, Savolainen, & Holopainen, 2011; Maughan 1995; Spreen, 1987). However, it is only in the last decade or so that we have started to study the association between poor reading and poor emotional health in earnest (Maughan & Carroll, 2006). The reliability of this association is not yet clear. While some studies have discovered that poor readers are at a higher risk for anxiety or depression than typical readers (e.g., Arnold et al., 2005; Morgan, Farkas, & Wu, 2012), other studies have not found evidence for an association between anxiety or depression and poor reading (Boetsch, Green, & Pennington, 1996; Miller, Hynd, & Miller, 2005).

Such mixed evidence is not unusual in the field of reading research. Many studies investigating poor reading have found mixed evidence for cognitive, neurophysiological,

or genetic deficits in poor readers (e.g., Fisher & DeFries, 2002). In many instances, further research has revealed that this mixed evidence occurs because only a subgroup (i.e., a proportion) of poor readers has a particular deficit, and studies that inadvertently recruit a greater number of poor readers from this subgroup are more likely to find evidence for an association between poor reading and that particular deficit than studies that do not. The question that inevitably arises from the discovery of a subgroup of poor readers with a particular deficit is what characteristics differentiate them from other poor readers who do not have that deficit. Since the existence of a subgroup of poor readers with anxiety or depression could explain the mixed evidence for an association between poor reading and anxiety or depression, the aim of this systematic review is to determine if either anxiety or depression is reliably associated with poor reading (Aim 1), and if so, what characterizes the subgroup of poor readers who suffer from anxiety or depression (Aim 2).

Anxiety is a natural response to a feared or dangerous stimulus. It can become maladaptive when fear or worry is excessive and interferes with daily functioning (American Psychiatric Association, 2013). Anxiety disorders tend to emerge during childhood (Kessler, Berglund, Demier, Jin, Merikangas, & Walters, 2005) and affect around 6.9% of children and adolescence (Ford, Goodman, & Meltzer, 2003). According to research, the most prevalent anxiety disorders affecting children include separation anxiety (Briggs-Gowan et al., 2000; Costello, Mustillo, Erkanli, Keeler, & Angold 2003), generalized anxiety, social anxiety, and specific phobias (Breton, Bergeron, Valla, Berthiaume, & Gaudet, 1999). The Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2013) outlines additional anxiety disorders, including selective mutism, panic disorder, agoraphobia, and generalized anxiety disorder. These different types of anxiety disorders have many overlapping symptoms, including somatic symptoms, problems sleeping, and avoidance behaviors (Mohatt, Bennett, &

Walkup, 2014).

Given that there are multiple anxiety disorders, it is important to determine if some types of anxiety are more likely to be associated with poor reading than others. While previous reviews have looked at the association between poor reading and anxiety and depression (Maughan & Carroll, 2006; Mugnaini, Lassi, La Malfa, & Albertini, 2009), no previous review has examined the associations between the different types of anxiety and poor reading. Thus, this review will use the outcomes of previous studies to consider the studies supporting (or not supporting) an association between poor reading and anxiety, as well as clarify which types of anxiety may and may not be associated with poor reading.

Children experiencing anxiety also commonly experience symptoms of depression (Garber & Weersing, 2010). Symptoms of depression include feelings of sadness, emptiness, and irritability that impair an individuals capacity to function efficiently. In terms of clinical disorders, the DSM-V classifies disruptive mood deregulation disorder, major depressive disorder, and persistent depressive disorder (previously dysthymia), as well as sub-threshold symptoms of depression (unspecified depressive disorder; American Psychiatric Association, 2013). Research suggests that major depressive disorder affects approximately 23- 25% of adolescents and adults (Kessler et al., 2005; Reinherz, Paradis, Giaconia, Stashwick, & Fitzmaurice, 2003), with slightly lower rates reported for persistent depressive disorder (Kim-Cohen, Caspi, Moffitt, Harrington, Milne, & Pulton, 2003) and sub-threshold disorders (Costello et al., 2003; Gonzalez-Tejera et al., 2005; Lewinsohn, Shankman, Gau, & Klein, 2004). In younger samples, depression affects around 5- 8% of children, and specifically between 0.3- 1.4% of preschool children (Egger & Angold, 2006; Stalets & Luby, 2006), 1- 2% of pre-adolescent children, and 3- 8% of adolescents (Lewinsohn, Clarke, Seeley, & Rohde, 1994).

Given the varying incidence of depressive disorders among children, adolescents and adults, it would seem prudent to understand the association between poor reading and different types of depression (disruptive mood deregulation disorder, major depressive disorder, persistent depressive disorder, and sub-threshold disorders) at different ages. Thus far, the three reviews that have looked at the association between poor reading and depressive symptoms have not explored the association between poor reading and different depressive disorders (e.g., Beitchman & Young, 1997; Maughan & Carroll, 2006; Mugnaini et al., 2009). Thus, this review will use the outcomes of previous studies to consider how many studies support (or do not support) an association between poor reading and depression, to identify which types of depression may or may not be associated with poor reading, and to understand if this relationship varies across different ages.

In addition to type of anxiety, type of depression, and age (discussed above), there are at least five additional factors that may influence or moderate the strength of an association between poor reading and anxiety or depression. These include type of reading difficulty, sex, type of school attended, and level of attention. Research to date suggests that a relationship may exist between these moderators and poor reading or anxiety or depression. However, research is yet to explore the potential moderators for the relationship between poor reading and anxiety and depression, and we are only just beginning to understand the association between poor reading and poor emotional health. As a starting point, we therefore aimed to determine if the factors that moderate the independent associations between reading and anxiety and depression also moderate the association between poor reading and poor emotional health.

In regard to sex, previous studies have found that females are more likely than males to experience anxiety (Bruce et al., 2005; McLean, Asnaani, Litz, & Hofmann 2011) as well as depression (Kessler, 2003). This raises the question of whether poor

reading and anxiety and depression are more reliably or strongly associated in females than males. Sex differences in poor readers with poor emotional health have not been examined before, and differences may exist between male and female poor readers.

Another factor that may moderate the association between poor reading and anxiety or depression is the type of school that a child attends. Previous studies have found that poor readers at mainstream schools experience bullying, and feel ostracized and stigmatized when receiving reading assistance (Glazzard, 2010; Mattson & Roll Pettersson, 2007). Research has also shown that children who experience bullying and negative school experiences have a higher incidence of depression, anxiety and poor emotional health outcomes compared to children who do not experience bullying (Craig, 1998). In contrast, poor readers at learning specialist schools report experiencing high self-concept and self-esteem (Burden & Burdett, 2005; Humphrey, 2002; Nugent, 2007) and a lower incidence of emotional health problems than poor readers in mainstream schools (Nalavany, Carawan, & Brown, 2011). In sum, previous research indicates that the type of school a child attends may moderate the relationship between children's reading ability and emotional health outcomes. It may therefore be important to explore if poor reading is more strongly associated with anxiety and depression in poor readers who attend mainstream schools than specialist schools. Thus, the present study aims to review the literature to determine if the type of school moderates the relationship between poor reading and anxiety or depression.

Yet another factor that may affect the association between poor reading and anxiety or depression is the type of reading impairment that a poor reader suffers. Grills-Taquechel, Fletcher, Vaughn, and Stuebing (2012) found that symptoms of separation anxiety were negatively predicted by reading fluency, while harm avoidance symptoms were positively predicted by decoding ability. This suggests that different types of anxiety, and perhaps different types of depression, may be associated with different types of

reading. Thus, it may therefore be important to determine if some reading impairments are more closely associated with anxiety or depression than others.

A further factor that may moderate the association between poor reading and anxiety or depression is inattention. Past research has found that a proportion of poor readers have problems with inattention and/or hyperactivity (Goldston et al., 2007; Levy, Young, Bennett, Martin, & Hay, 2013; Wilcutt & Pennington, 2000). Recent research has also shown that anxiety is associated with inattention rather than hyperactivity (Michelini, Eley, Gregory, & McAdams, 2015). In combination, these findings raise the possibility that an association between poor reading and anxiety (and perhaps depression) may be stronger in poor readers with poor attention rather than those with typical attention. Given the evidence for associations between poor reading, inattention, anxiety and depression, we aimed to determine whether the relationship between poor reading and emotional health exists independent of inattention.

In sum, there is mixed evidence for an association between poor reading and anxiety and depression. This mixed evidence may exist because only a subgroup of poor readers have anxiety or depression. Thus the aim of this systematic review is to try and gain a clearer understanding of the relationship that might exist between poor reading and anxiety or depression by determining (1) whether anxiety or depression are reliably associated with poor reading, and (2) what characterizes poor readers who suffer from anxiety or depression with regards to their type of anxiety, type of depression, age, sex, type of school attended, type of reading impairment, and level of attention.

Methods

Electronic Searches

Key electronic database searches (MEDLINE, PsycINFO, EMBASE, WILEY, and PubMed) were conducted. Databases were searched for articles published in English. No

dates were specified in the search, but articles ranged from 1965 to 2015. The search terms were restricted to the title and abstract, text words, and keywords relevant to the following terms and adapted for each database:

1. Reading/
2. (read$ adj3 disorder$).tw.
3. (read$ adj3 (abilit$ or disab$)).tw.
4. (read$ adj3 impair$).tw.
5. (read$ adj3 defic$).tw.
6. (read$ adj3 delay$).tw
7. (read$ adj3 dysfunction$).tw.
8. (poor$ adj3 read$).tw.
9. (dysfluen$ adj3 read$).tw.
10. (slow$ adj3 read$).tw.
11. (remedial adj3 read$).tw.
12. dyslexia/
13. dyslex$.tw.
14. (word-blind$ or wordblind$).tw.
15. or/1-14
16. anx$.tw.
17. fear$.tw.
18. panic.tw.
19. phobi$.tw.
20. worr$.tw.
21. inhibit$.tw.
22. shy$.tw.
23. internal$.tw.
24. or/16-23

25. depress$.tw.

26. affect$.tw.

27. mood.tw.

28. internali$.tw.

29. or/25-28

Selection of Studies

The database search initially identified 1244 studies. Hand-searching reference lists of seminal papers and key review articles identified an additional 25 studies for possible review. After duplicates were removed, one reviewer (DF) screened the remaining 1231 studies for eligibility using titles and abstracts. All accepted articles (N = 29) were downloaded, and two independent reviewers (DF and NC) examined each article in full to assess eligibility in detail. The two reviewers independently evaluated the articles and agreed on all selected studies and data extracted. There was only one discrepancy between the reviewers (in regards to a complex analysis) and independent re-evaluation of the article by each reviewer resolved the discrepancy and the reviewers reached agreement to include the article without the requirement of a third reviewer. This resulted in 17 studies that met the eligibility criteria. The final data were extracted using the forms in Appendix B (for anxiety) and Appendix C (for depression). Twelve studies were excluded from final analysis because they failed to meet the strict eligibility criteria outlined below. A summary of the review process is provided in the flow diagram shown in Figure 1.

Eligibility Criteria

This study adhered to strict inclusion criteria, namely, poor readers must perform at or below one SD, one year, or one grade below the expected level despite no reported social, emotional, or physical problems that could explain their impaired ability to learn to read. While there are discrepancies between studies in how poor reading is defined, these criteria are commonly used in studies on poor readers, which will enhance comparability

with the field. Participants completed the study in their primary language, and their reading was measured explicitly within the study using tests of word reading accuracy, reading fluency, or reading comprehension. In addition, anxiety or depression was measured directly in participants using quantitative questionnaires that had normative data. Studies that administered either qualitative questionnaires or indirect questionnaires to parents and/or teachers (rather than to participants themselves) were not included since qualitative and indirect measures of anxiety and depression may be less reliable and valid than direct quantitative measures (Boetsch et al., 1996).

Data Extraction

Data were extracted from the 17 articles that met the eligibility by the two independent reviewers (DF, NC) using customised forms (see Appendix A) that collected information including type of anxiety, type of depression, age of participants, sex of participants, type of school attended by participants, type of reading impairment demonstrated by participants, participants' attentional capacities, as well as the anxiety or depression outcomes.

Regarding type of anxiety, we recorded whether studies measured (1) social anxiety, which refers to a marked and persistent fear of negative evaluation in social or performance situations; (2) separation anxiety disorder, which is defined as intense fear when separated from caregivers; (3) generalized anxiety disorder, which is diagnosed when at least 6-months of excessive anxiety and worry interferes with daily functioning; (4) specific phobia, which is a marked and persistent fear of an object or situation; and (5) physical symptoms of anxiety, which may include bodily perspiration, feelings of nausea, or shaking and trembling (American Psychiatric Association, 2013). We also recorded if poor readers had (6) state anxiety, which is a transient and subjective fear and worry when a person perceives a particular situation as dangerous; and trait anxiety, which is a general

level of distress that may be considered as an individual's predisposition towards experiencing anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

Regarding type of depression, we noted whether a study measured (1) major depressive disorder, which is characterized by one or more major depressive episodes in addition to four or more symptoms of depression; (2) persistent depressive disorder, which is defined by depressed mood for most of the day, for more days than not, for a period of at least two years; and (3) other specified depressive disorder, which is defined by symptoms of depression that do not meet criteria for another clinical depressive disorder (American Psychiatric Association, 2013).

In terms of age, we noted whether studies included (1) children (6- 12 years), (2) adolescents (13- 17 years), or (3) adults (18 years and above). We recorded their age in years or months, and also the grade of school or university they attended.

Regarding sex, we recorded whether studies recruited (1) similar sample sizes of females and males (i.e., the difference in females and males did not exceed 10); (2) more females (i.e., there were 10 or more females than males); (3) more males (i.e., there were 10 or more males than females); and (4) the number of females and males in the study was not reported. While we acknowledge that "10" is an arbitrary number, we wanted to select a substantial cut-off point that would show bias was evident in one group (i.e., male) compared to another (i.e., female).

For the type of school, we noted whether studies recruited participants from (1) a mainstream school; (2) specialist learning school; (3) college or university; and (4) the type of school participants recruited from was not reported.

For type of reading impairment, we recorded whether poor readers in each study were assessed on tests for (1) word reading accuracy; (2) letter-word identification; (3) phonological recoding; (4) reading fluency; (5) reading comprehension; and (6) spelling.

In terms of attention, we intended to collect data on whether each study recruited poor readers with poor attention or typical attention. However, no study that has investigated anxiety or depression in poor readers has explicitly recruited poor readers with typical attention. Instead, studies do not control or report attention, or they statistically control for attention in their sample. Thus, we recorded whether each study (1) did not report whether or not poor readers had poor attention, or (2) controlled for poor attention statistically. This provided some insight into whether poor reading was associated with anxiety of depression in poor readers with (presumably) heterogeneous levels of attention (i.e., option 1 above) or poor readers regardless of attention (i.e., option 2 above).

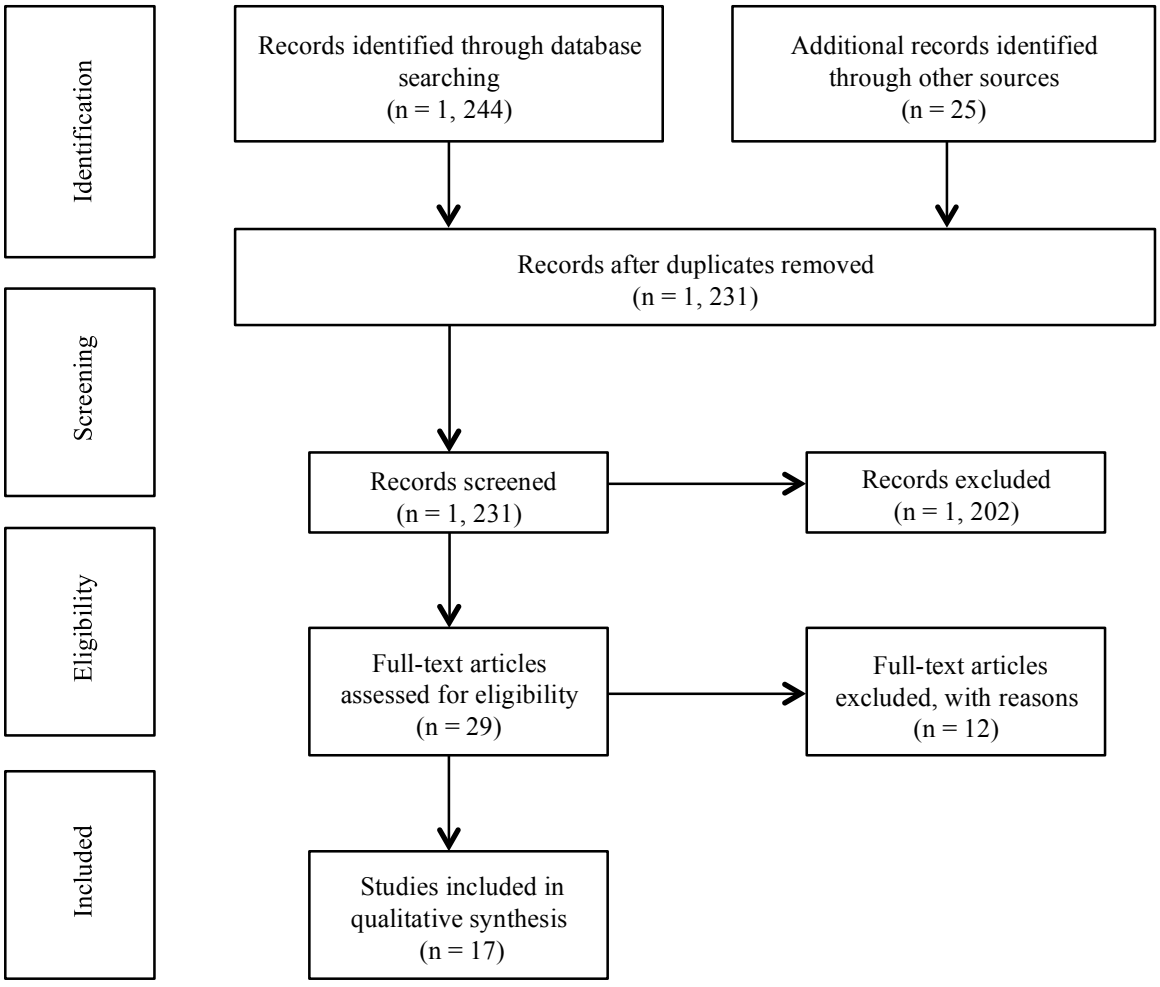

Figure 1. Flowchart of the study selection and data extraction process.

Results

Anxiety

Fourteen studies that examined the association between poor reading and anxiety met the criteria for this systematic review (see Table 1). Eleven of these 14 studies found evidence of an association between poor reading and anxiety (see columns 3 and 4 of Appendix B) while three studies did not (see columns 5 and 6 of Appendix B). Thus, more studies support an association between poor reading and anxiety.

Type of anxiety. Symptoms of social anxiety were measured in seven studies, three of which showed an association between social anxiety and poor reading, and four of which did not. Thus, the evidence suggests that there is not a reliable association between poor reading and symptoms of social anxiety.

Separation anxiety disorder was tested in one study, while symptoms of separation anxiety were tested in three studies. The study measuring separation anxiety disorder found an association with poor reading, while two of the separation disorder symptom studies found an association, while one did not. Thus, more studies suggest, albeit a limited number, that poor reading may be associated with separation anxiety disorder and/or symptoms.

Generalized anxiety was tested in five studies. All five studies found that poor readers had higher levels of generalized anxiety symptoms, but one study also found evidence against poor readers and symptoms of generalized anxiety. Nonetheless, more studies support association between poor reading and symptoms of generalized anxiety.

Specific phobia was tested in three studies. No study found an association between poor reading and specific phobia. Thus, the limited evidence to date suggests that poor reading is not associated with specific phobia.

Physical symptoms of anxiety were tested in three studies. No study found an association between physical symptoms and poor readers. Thus, there is currently no evidence to support an association between poor reading and physical symptoms of anxiety.

State anxiety was tested in two studies. One study found poor readers had state anxiety on one measure (STAI; Spielberger et al., 1970), but did not have state anxiety on a second measure (STAXI-2; Spielberger, 1999). The second study did not find an association between state anxiety and poor readers. Thus, more studies, whilst again a limited number, do not favor an association between poor reading and state anxiety.

Trait anxiety was tested in three studies. Two studies found an association between poor reading and trait anxiety while one study did not. Thus, more studies, although a very limited number, do not favor an association between poor reading and trait anxiety.

Age. The age mean, range, and median scores of the 11 studies that found an association between poor reading and anxiety, and the three studies that did not find an association between poor reading and anxiety, are shown in Appendix B. The median and range of ages for the anxiety studies that did and did not find and association between poor reading and anxiety were similar. This suggests that age may not moderate a poor reader's risk of having anxiety.

Sex. Of the 11 studies that found an association between poor reading and anxiety, four recruited more males than females, and four used a similar number of females and males. Only one study recruited more females than males, and two studies failed to report the number of males and females. Of the three studies that did not find an association between poor reading and anxiety, two did not report numbers of males and females, and one study recruited similar numbers of females and males. Considered en masse, these findings might be taken to tentatively suggest that the inclusion of males in a sample may increase the likelihood of finding an association between poor reading and anxiety.

However, this suggestion must be considered with caution since it is based on indirect evidence. That is, no previous study has directly compared males and females when investigating the association between poor reading and anxiety.

Type of school. Six of the 11 studies that found an association between poor reading and anxiety did not report whether poor readers came from mainstream schools or not. The remaining five studies recruited poor readers from mainstream schools. Of the three studies that did not find an association between poor reading and anxiety, one study recruited poor readers from mainstream schools while two studies did not report this information. Given that no studies reported whether children attended specialist schools, the association between poor reading and anxiety and type of school remains unknown.

Type of reading impairment. The 14 anxiety studies included in this review tested a wide variety of reading impairments including word reading accuracy (10 studies), letterword identification (five studies), phonological recoding (five studies), reading fluency (seven studies), reading comprehension (six studies), and spelling (four studies). A comparison of studies that did and did not find evidence for anxiety in poor readers revealed no particular pattern in subtypes of poor reading

Attention. As mentioned above, the 14 studies in the anxiety review were categorized (see Appendix B) according to whether they controlled for poor attention statistically or did not report whether or not poor readers had poor attention. Around half the studies that found an association between poor reading and anxiety, and half the studies that did not find such an association, controlled for attention statistically. The remaining studies did not report the attention levels of poor readers. Five of the six studies that controlled for attention found evidence for an association between poor reading and anxiety. This argues against the idea that only poor readers with poor attention have anxiety. Thus, the association between poor reading and anxiety is likely to be independent of attention.

Table 1

Studies measuring the association between poor reading and anxiety

#	Study	Design	Dyslexia							Control				Measures	
			Criteria	N	Age/ grade	Sex (F/M)	IQ	Attention	Country Language	School	Criteria	N	Age/ grade	Sex (F/M)	IQ	Reading	Anxiety
Evidence for an Association between Poor Reading and Anxiety																	
1A	Undheim (2003)	Longitudinal	Two definitions of dyslexia: 1. Discrepancy between reading and general ability 2. Discrepancy between reading and spelling AND general ability	32	*M*=23y / NR	10/22	NR	Not controlled	Norway Norwegian	NR	Completed a language and ability test at screening (age 10y) and did not meet 'dyslexia criteria'	973	*M*=23y / NR	507/466	NR	Comprehension • Experimental comprehension test (NR) Reading Accuracy: • Experimental single word test (NR)	SCL-90-R • Obsessive-compulsive • Anxiety (X) • Phobic Anxiety
2A	Grills-Taquechel et al. (2012)	Longitudinal	Identified as 'at risk' readers on TRI. 'At risk' criteria not specified. The reader is referred to Denton et al. (2011)	87	NR / Gr 1	69/84 (overall sample)	NR	Not controlled	U.S. English	NR	Identified as 'typical achieving' on TRI. Criteria not specified.	35	NR/Gr	169/84 (overall sample)	NR	Letter-Word Identification: • WJ-III: Letter-word identification (X) Phonemic Recoding: • WJ-III: Word Attack Reading Fluency: • CMERS: Oral Reading Fluency (X) Unknown Impairment: • TRI: (X)	MASC: • Physical symptoms • Harm avoidance (X) • Social anxiety • Separation anxiety/panic (X) • Total anxiety (X)
3A	Goldston et al. (2007)	Longitudinal	Single word reading skills below a raw score of 45 and below the 18th percentile (Grigorenko et al., 2000). Letter-word identification skills below the 16th percentile. Definition guided by previous genetic studies examining single word reading impairment phenotype.	94	NR / NR Screened at 15y	45/55 (%) (overall sample)	NR	Statistically	U.S. English	Mainstream Public School	Raw score greater than 45 on WJ-III letter word identification and test of single word reading.	94	NR / NR	45/55 (%) (overall sample)	NR	Letter-Word Identification: • WJ-III: Letter-word identification (X) Reading Accuracy: • WJ-III: Single word reading test (X)	K-SADS: • Generalised anxiety disorder (X) • Social phobia (X) • Overall anxiety (X) • Simple Phobia
4A	Bonifacci et al. (2014)	Group comparison	Parents: Performance on questionnaire indicated parents had history of dyslexia. Children: IQ not below 1SD and a significant reading impairment at least 2SD below on any one measure	39	*M*=43.9, SD=5y / NR	NR	Average	Not controlled	Italy Italian	NR	NR	41	*M*=43.3, *SD*=6 y / NR	NR	Average	Reading Fluency: • Nonword Reading (X) • Passage Reading (X) Reading Accuracy: • Nonword Reading (X)	STAI-XI • State anxiety STAI-X2: • Trait Anxiety (X) •
5A	Carroll & Iles (2006)	Group comparison & correlation	Below average TOWRE and 'previous diagnosis'	16	*M*=21.5 y / NR	13/3	NR	Not controlled	U.K. English	NR	No previously reported learning or reading disabilities and average TOWRE word and nonword (within 1SD)	16	21.6 y	13/3	NR	Reading Accuracy: • TOWRE: Sight word (X) Reading Fluency: • TOWRE: Nonword (X)	STAI: • State anxiety (X) • Trait anxiety SEAQ-T: • Academic anxiety (X) • Social anxiety (X) • State anxiety • Appearance anxiety
6A	Arnold et al. (2005)	Longitudinal	WJ-III letter word identification raw score at or below 44, corresponding to at or below the 18th percentile	94	*M*=15 y / NR	42/52	NR	Statistically	U.S. English	Mainstream Public School	WJ-III letter word identification raw score above 44, corresponding to above the 18th percentile	94	*M*=15 y / NR	40/54	NR	Letter-Word Identification: • WJ-III (X): Letter-word identification (X) Phonological Decoding: • WJ-III: Word attack (X) • TAAS: Decoding (X) Comprehension: • LAC: Comprehension (X)	STAI: • Trait anxiety (X)
7A	Grills-Taquechel et al. (2013)	Longitudinal	PR were classified as 'at risk' for reading difficulties in a previous study, and continued to show reading difficulties over an 8-week	35	*r*=6-8y / Gr 1 *r*=6-8y / Gr 1	NR	NR	Statistically	U.S. English	Mainstream Primary School	Controls classified as false positive at risk or typical achievers based on an assessment from a previous	41	*r*=6-8y / Gr 1	NR	NR	Reading Accuracy: • TOWRE: Sight word (X) • Basic Reading (X) Reading Fluency:	MASC: • Physical symptoms • Harm avoidance (X) • Social anxiety

			period.								study.									
																			• TOWRE: Nonword (X) Comprehension: • WJ-III: Passage Comprehension (X) Unknown Impairment: • TPRI: (NR)	• Separation anxiety (X)
8A	Carroll et al. (2005)	Cross-sectional	Sample included the lowest 5% of children with reading and spelling furthest below their predicted score, with average vocabulary performance.	289	*r*=5-15 y / NR	68/221	NR	Statistically	U.K. English	NR	Did not meet criteria for poor reading ability	5463	*r*=9-15 y / NR	NR	NR	Reading Accuracy: • BAS-II: Single word reading (X) Spelling: BAS-II: Spelling (X)	DAWBA • Separation anxiety (X) • Generalised anxiety disorder (X) • Social phobia • Specific phobia • Panic • Agoraphobia • Other anxiety disorders
9A	Mammarella et al. (2014)	Group comparison	Previously diagnosed reading disability and impaired decoding ability	15	*M*=125, *SD*=17.06 y / NR	7/8	Average	Not controlled	Italy Italian	Mainstream Primary school	NR	15	*M*=116.67, *SD*=17.46 y / NR	Average	• Experimental Reading Speed Test (X) Reading Accuracy: • Experimental Reading Accuracy Test (X) Comprehension: • Experimental Comprehension Test	Reading Fluency: • Experimental Reading Speed Test (X) Reading Accuracy: • Experimental Reading Accuracy Test (X) Comprehension: • Experimental Comprehension Test	SAFA: • Generalised anxiety (X) • Social anxiety (X) • Separation anxiety • School Anxiety
10 A	Nelson et al. (2013)	Correlation	Diagnosed by a psychologist. Word recognition, decoding, fluency, and another on spelling and reading comprehension at or below a standard score of 85.	50	*M*=20.36 / NR	25/25	WAIS-IV *M*=95.35, *SD*=11.83	Not controlled	U.S. English	College/University students	NR	50	*M*=19.26 y / NR	25/25	NR	• TOWRE: Sight word (X) Reading Fluency: • TOWRE: Nonword (X) Phonemic Recoding: • WJ-III: Word Attack (X) Letter-Word Identification: • WJ-III: Letter-word identification (X) Comprehension: • WJ-III: Comprehension (X)	TAI: • Worry (X) AMAS-C: • Test anxiety (X) • Worry/over sensitivity • Social concerns/stress • Physiological anxiety
11 A	Willcutt & Pennington (2000)	Regression	History of reading difficulties during high school AND fall below age average on a standardised reading assessment	209	*M*=10.5, *SD*=2.2 y / NR	89/120	NR	Statistically	U.S. English	NR	Participants with a score above 1.65 standard deviation on the PIAT composite score	192	*M*=10.7, *SD*=2.3 y / NR	97/95	Average	Reading Accuracy: • PIAT: Reading recognition (X) Comprehension: • PIAT: Comprehension (X) Spelling: • PIAT: Spelling (X)	DICA-C: • Overanxious disorder (X)
											Evidence for No Association between Poor Reading and Anxiety						
12 A	Miller et al. (2005)	Group comparison	Two groups and definitions of dyslexia: 1. PR1: Discrepancy Model. 20-point discrepancy between IQ standard score and reading ability AND a score below 85 on WRMT-R subtests. 2. PR2: Reading Cut-Off Model. Score below 85 on WRMT-R subtests.	PR1 (*n*=20) PR2 (*n*=2) 4)	PR1 *M*=128.64m 18.79 m / NR PR2 *M*=132.20m *SD*=25.00 m / NR	NR	*M*=96.10, *SD*=13.03 R=66-116	Not controlled	U.S. English	NR	Two definitions for control participants: 1. C1: Discrepancy Model. Score greater than 85 on WRMT-R subtests. 2. C2: Reading cut-off Model. Score above 85 on WRMT-R subtests.	59	C1 *M*=127.66 m *SD*=27.34 m / NR C2 *M*=125.80m *SD*=26.33m / NR	NR	*M*=102, *SD*=14.04 *R*=68-104	Letter-Word Identification: • WRMT-R: Letter-word identification (X) Phonological Recoding: • WRMT-R: Word Attack (X)	RCMAS • Anxiety
13 A	Nelson & Gregg (2012)	Group comparison	Significant difficulty with accurate and/or fluent word recognition, decoding, and spelling. Below the 25th percentile on two measures of word reading, nonword	60	*M*=19.39 y *SD*=1.62y / NR	30/30	Average	Statistically	U.S. English	Mainstream College	Questionnaire assessment to rule out previous diagnosis of dyslexia and/or ADHD. Reading ability was not measured for controls.	60	*M*=19.57y *SD*=1.10y / NR	30/30	Average	Letter-Word Identification: • WJ-III (X): Letter-word identification (X) Phonological Recoding: • WJ-III: Word attack (X)	BAI: • Anxiety

			reading, spelling, or fluency.															Reading Fluency: • WJ-III: Reading Fluency (X) Spelling: • WJ-III: Spelling (X) • Spelling of sounds (X)	
14 A	Boetsch et al. (1996)	Group comparison	Significant difference between observed reading and spelling performance and the level expected. PIAT discriminant function score below zero.	18	*M*=45.67 *SD*=7.8 y / NR	NR	Average	Not controlled	U.S. English	NR	PIAT discriminant function score greater than zero.	18	*M*=45.7 8, *SD*=5.2 3 y / NR	0/18	Average	Reading Accuracy: • PIAT: Reading Recognition (X) Comprehension: • PIAT: Reading Comprehension (X) Spelling: • PIAT: Spelling (X)	Dimensions of Depression Profile: • Anxiety

Reading tests: California Achievement Test (CAT; McGaw-Hill, 1992); Lindamood Auditory Comprehension Test (LAC; Lindamood & Lindamood, 1973); Peabody Individual Achievement Test (PIAT; Dunn & Markwardt, 1970); Rapid Automatised Naming (RAN); Test of Auditory Analysis Skills (TAAS; Rosner, 1979); Woodcock Johnson III test of achievement (WJ-III).

Anxiety tests: Adult Manifest Anxiety Scale (AMAS; Reynolds, Richmond, & Lowe, 2003); Beck Anxiety Inventory (BAI; Beck, 1999); Development and Well-Being Assessment (DAWBA; Goodman, Ford, Richards, Gatward, & Meltzer, 2000); Diagnostic interview for children and adolescents (DICA-C; Reich, 2000); Multidimensional Anxiety Scale for Children (MASC; March, 1997); Revised Childhood Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 2000); Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic Version (K-SADS; Orvaschel & Puig-Antich, 1994); Self-Administered Psychiatric Scales for Children and Adolescents (SAFA; Cianchetti & Fancello, 2001); Self-Evaluation Anxiety Questionnaire-Trait Anxiety (SEAQ-T; Spielberger, 1977); State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983); Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994);

Acronyms: C = controls; C1 = control group one; C2 = control group two; Gr= Grade; IQ= intelligent quotient; m=months; M=mean; NR = Not Reported; P1 = poor readers group one; P2= poor readers group two; PR = poor readers; r=range; SD=standard deviation; X = PR impaired on test; y=years.

Depression

Twelve studies that examined the association between poor reading and depression met the criteria for this systematic review (see Table 2). Six of these 12 studies found evidence to support an association between poor reading and depression (see columns 3 and 4 of Appendix C) while six studies did not (see columns 5 and 6 of Appendix C). Thus, there is no clear evidence for, or against, an association between poor reading and depression.

Type of depression. Only one study examined a clinical diagnosis of depression according to diagnostic criteria (i.e., major depressive disorder was tested in one study by Daniel et al., 2006). All other studies assessed only symptoms of depression and no other study assessed diagnoses of depression. Therefore, the studies were assessed in terms of symptoms of depression. The remaining 11 studies reported "total depression" scores, which include feelings of sadness, emptiness, and withdrawal. Four studies found an association between poor reading and depressive symptoms, while seven did not. Thus the studies reviewed suggest that there is not a reliable association between poor reading and symptoms of depression.

Age. Studies that found an association between poor reading and depression included children and adolescents aged from 5- 16 years. Studies that did not find an association between poor reading and depression included a larger age range of participants, who were aged from 10.8- 45.6 years. These statistics might be interpreted as evidence that younger samples are more likely to demonstrate an association between poor reading and depression. However, there is a great deal of overlap between these age ranges, and so this suggestion must be treated with extreme caution.

Sex. Of the six studies that found an association between poor reading and depression, four recruited more males than females, two recruited similar numbers of males and females, and one study failed to report the number of males and females. Of the

six studies that did not find an association between poor reading and depression, two reported more males than females, one reported a similar number of males and females, and three studies failed to report the number of males and females. Considered together, these findings may suggest that including males in a sample may increase the likelihood of finding an association between poor reading and depression. However, as previously mentioned this suggestion must be considered with caution since it is based on indirect evidence. That is, no previous study has directly compared males and females when investigating the association between poor reading and depression.

Type of School. Of the six studies that found an association between poor reading and depression, four included participants from mainstream schools, while two studies did not report this information. Studies that did not find an association between poor reading and depression comprised two studies from mainstream schools and four studies that did not report information about school type. Thus, there appears to be no consistent pattern of results to suggest that mainstream schools moderate the relationship between poor reading and depression.

Type of reading impairment. The 12 depression studies included in this review tested a wide variety of reading impairments including word reading accuracy (six studies), letter-word identification (four studies), phonological recoding (four studies), reading fluency (three studies), reading comprehension (five studies), and spelling (four studies). A comparison of the studies that did, and did not, find evidence for depression in poor readers revealed no particular pattern for the subtypes of poor reading.

Attention. None of the 12 depression studies excluded poor readers with poor attention. Half of the studies that did find an association between poor reading and depression controlled for attention statistically while the other half did not. Of the studies that did not find an association between poor reading and depression, two controlled for attention statistically and four did not. This evidence does not support the idea that poor

readers with poor attention are more likely to have depression than those without attention difficulties.

Table 2

Studies examining the association between poor reading and depression

#	Study	Design	Dyslexia							Control					Measure	
			Criteria	N	Age/ grade	Sex (F/M)	IQ	Attention	Country Language	School	Criteria	N	Age/ grade	Sex (F/M)	IQ	Reading	Depression
Evidence for an Association between Poor Reading and Depression																	
1D	Willcutt & Pennington (2000)	Regression	History of reading difficulties during high school AND fall below age average on a standardised reading assessment	209	*M*=10.5, *SD*=2.2y / NR	89/120	NR	Statistically	U.S. English	NR	Participants with a score above 1.65 standard deviation on the PIAT composite score	192	*M*=10.7, *SD*=2.3 y / NR	97/95	Average	Reading Accuracy: • PIAT: Reading recognition (X) Comprehension: • PIAT: Comprehension (X) Spelling: • PIAT: Spelling (X)	CDI: • Depressed mood (X)
2D	Maughan et al. (2003)	Cross sectional: Regression/ correlational	CAT 6th percentile or below and continue to show reading difficulties at wave two	134	Gr 1 /*M*=7.4 y Gr 4 / *M*=10.7 y Gr 7 / *M*=13.8 y	0/134	NR	Statistically	U.S. English	Mainstream Public School	Measured by CAT. *Not reported.	1282	NR	0/1282	NR	CAT (NR)	SMFQ • Depressed mood (X)
3D	Arnold et al. (2005)	Longitudinal	WJ-III letter word identification raw score at or below 44, corresponding to at or below the 18th percentile	94	*M*=15 y / NR	42/52	NR	Statistically	U.S. English	Mainstream Public School	WJ-III letter word identification raw score above 44, corresponding to above the 18th percentile	94	*M*=15 y / NR	40/54	NR	Letter-Word Identification: • WJ-III (X): Letter-word identification (X) Phonological Recoding: • WJ-III: Word attack (X) • TAAS: Decoding (X) Comprehension: LAC: Comprehension (X)	YSR: • Emotional symptoms BDI: • Depressed mood (X)
4D	Daniel et al. (2006)	Longitudinal	WJ-III letter word identification raw score below 45, equivalent to the 18th percentile or below.	94	*M*=15.4 y/ *r*=15.0, 15.8 y / NR	42/52	NR	Not controlled	U.S. English	Mainstream High School	WJ-III letter word identification raw score above 45, equivalent to above the 18th percentile.	94	15.4 y	40/54	NR	Letter-Word Identification: • WJ-III (X) Phonological Recoding • WJ-III: Word attack (X)	K-SADS: • Major depressive disorder (X)
5D	Morgan et al. (2012)	Longitudinal	Bottom 10% of the cohort for performance on the ECLS-K reading battery	331	NR / Gr 3	NR	NR	Not controlled	U.S. English	Mainstream Primary School	Top 90% of the cohort for performance on the ECLS-K reading battery	2977	NR / Gr 3	NR	NR	Reading Accuracy: • ECLS-K: Accuracy (X) Comprehension: • ECLS-K: Comprehension (X)	SDQ-1: • Sad & lonely (X) • Unpopular (X)
6D	Mammarella et al. (2014)	Group comparison	Previously diagnosed reading disability and impaired decoding ability	15	*M*=125, *SD*=17.06 y / NR	7/8	Average	Not controlled	Italy Italian	Mainstream Primary school	NR	15	*M*=116.67, *SD*=17.46 y / NR	5/10	Average	Reading Fluency: • Experimental Reading Speed Test (X) Reading Accuracy: • Experimental Reading Accuracy Test (X) Comprehension: • Experimental Comprehension Test	CDI: • Depressed mood (X)
Evidence for No Association between Poor Reading and Depression																	
7D	Boetsch et al. (1996)	Group comparison	Significant difference between observed reading and spelling performance and the level	18	*M*=45.67 *SD*=7.8 y / NR	NR	Average	Not controlled	U.S. English	NR	PIAT discriminant function score above zero.	18	*M*=45.78, *SD*=5.23 y / NR	0/18	Average	Reading Accuracy: • PIAT: Reading Recognition (X)	CES-D: • Depressive symptoms Dimensions of Depression

			expected. PIAT discriminant function score below zero.																Comprehension: • PIAT: Reading Comprehension (X) Spelling: • PIAT: Spelling (X)	Profile: • Global self-worth • Mood • Energy • Suicidal Ideation • Self-Blame • General Hopelessness
8D	Undheim (2003)	Longitudinal	Two definitions of dyslexia: 3. Discrepancy between reading and general ability Discrepancy between reading and spelling AND general ability	32	*M*=23y / NR	10/22	NR	Not controlled	Norway Norwegian	NR	Completed a language and ability test at screening (age 10y) and did not meet 'dyslexia criteria'	973	*M*=23y / NR	507/466	NR				Comprehension • Experimental comprehension test (NR) Reading Accuracy: Experimental single word test (NR)	SCL-90-R • Depressed mood
9D	Carroll et al. (2005)	Cross-sectional	Sample included the lowest 5% of children with reading and spelling furthest below their predicted score, with average vocabulary performance.	289	*r*=5-15 y / NR	68/221	NR	Statistically	U.K. English	NR	Did not meet criteria for poor reading ability	5463	*r*=9-15 y / NR	NR	NR				Reading Accuracy: • BAS-II: Single word reading (X) Spelling: BAS-II: Spelling (X)	SMFQ: • Depressed mood DAWBA • Depression
10 D	Miller et al. (2005)	Group comparison	Two groups and definitions of dyslexia: 3. PR1: Discrepancy Model. 20-point discrepancy between IQ standard score and reading ability AND a score below 85 on WRMT-R subtests. 4. PR2: Reading Cut-Off Model. Score below 85 on WRMT-R subtests.	PR1 (*n*= 20) PR2 (*n*=2 4)	PR1 *M*=128.6 4m *SD*= 18.79 m / NR PR2 *M*=132.2 0m *SD*=25.00 m / NR	NR	*M*=96.1 0, *SD*=13. 03 R =66-116	Not controlled	U.S. English	NR	Two definitions for control participants: 1. C1: Discrepancy Model. Score greater than 85 on WRMT-R subtests. 2. C2: Reading cut-off Model. Score above 85 on WRMT-R subtests.	59	C1 *M*=127.6 6 m *SD*=27.34 m / NR C2 *M*=125.80 m *SD*=26.33 m / NR	NR	*M*=102. *SD*=14. 04 *R*=68-104				Letter-Word Identification: • WRMT-R: Letter-word identification (X) Phonological Recoding: • WRMT-R: Word Attack (X)	CDI • Depressed mood
11 D	Nelson & Gregg (2012)	Group comparison	Significant difficulty with accurate and/or fluent word recognition, decoding, and spelling. Below the 25th percentile on two measures of word reading, nonword reading, spelling, or fluency.	60	*M*=19.39 y *SD*=1.62y / NR	30/30	Average	Statistically	U.S. English	Mainstream College	Questionnaire administered to rule out previous diagnosis of dyslexia and/or ADHD. Reading ability was not measured for controls.	60	*M*=19.57 y *SD*=1.10y / NR	30/30	Average				Letter-Word Identification: • WJ-III (X): Letter-word identification (X) Phonological Recoding: • WJ-III: Word attack (X) Reading Fluency: • WJ-III: Reading Fluency (X) Spelling: • WJ-III: Spelling (X) • Spelling of sounds (X)	BDI-II: • Depressed mood
12 D	Bonifacci et al. (2014)	Group comparison	Parents: Performance on questionnaire indicated parents had history of dyslexia. Children: IQ not below 1SD and a significant reading impairment at least 2SD below on any one measure	39	*M*=43.9, SD= 5y / NR	NR	Average	Not controlled	Italy Italian	NR	NR	41	*M*=43.3; *SD*=6 y / NR	NR	Average				Reading Fluency: • Nonword Reading (X) • Passage Reading (X) Reading Accuracy: • Nonword Reading (X)	Depression Questionnaire: • Depressed mood

Reading tests: California Achievement Test (CAT; McGaw-Hill, 1992); Lindamood Auditory Comprehension Test (LAC; Lindamood & Lindamood, 1973); Peabody Individual Achievement Test (PIAT; Dunn & Markwardt, 1970); Rapid Automatised Naming (RAN); Test of Auditory Analysis Skills (TAAS; Rosner, 1979); Woodcock Johnson III test of achievement (WJ-III).

Depression Tests: Beck Depression Inventory (BDI-II; Beck, 1996); Child Depression Inventory (CDI; Kovacs, 1985); Development and Well-Being Assessment (DAWBA; Goodman, Ford, Richards, Gatward, & Meltzer, 2000); Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic Version (K-SADS; Orvaschel & Puig-Antich, 1994); Self-Description Questionnaire (SDQ-1; Marsh, 1990); Short Version Mood and Feelings Questionnaire (SMFQ; Agnold et al., 1995); Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994); The Centre for Epidemiologic studies depression scale (CES-D; Radloff, 1977); Youth Self-Report Inventory (YSR; Achenbach & Rescorla, 2001).

Acronyms: C = controls; C1 = control group one; C2 = control group two; Gr= Grade; IQ= intelligent quotient; m=months; M=mean; NR = Not Reported; P1 = poor readers group one; P2= poor readers group two; PR = poor readers; r=range; SD=standard deviation; X = PR impaired on test; y=years.

Discussion

This systematic review aimed to explore whether anxiety or depression was reliably associated with poor reading (Aim 1), and to determine what characterizes poor readers who suffer from anxiety or depression (Aim 2). A systematic search of the literature identified 17 studies that satisfied inclusion criteria. Below we use the outcomes of these studies to address each aim in turn. We then consider the implications for the association between poor reading and anxiety, as well as poor reading and depression. We finish by suggesting directions for future research.

Aim 1: To determine if anxiety or depression are reliably associated with poor reading

There appears to be an association between poor reading and anxiety, with 11 of the 14 studies finding an association between poor reading and anxiety. This association is consistent with previous reviews that have examined the relationship between poor reading and anxiety (Maughan & Carroll, 2006; Mugnaini et al., 2009). However, unlike previous reviews, this systematic review was the first to specifically examine the association between poor reading and the different types of anxiety. Our findings suggest that poor reading may be associated with symptoms of separation anxiety, generalized anxiety, and trait anxiety. In contrast, no association was found between poor reading and symptoms of social anxiety, phobias, state anxiety, or physical symptoms of anxiety. Thus, poor reading appears to be reliably associated with some types and symptoms of anxiety but not others.

Why might poor reading be associated with separation anxiety? One possibility is that poor reading causes separation anxiety. Poor readers face difficulty learning to read on a daily basis at school, and this repeated difficulty might trigger symptoms of separation anxiety when children attempt to cope with such a significant stressor. This is supported to some extent by research that found symptoms of separation anxiety are

triggered when children attempt to cope with transitions (i.e., starting a new Grade at school) or stressors (i.e., poor reading performance in class; Eisen, Brien, Bowers, & Strudler, 2001). Alternatively, separation anxiety might cause poor reading because children with separation anxiety may have trouble engaging with, and hence practicing, reading tasks (Ialongo, Edelsohn, Werthammer-Larsson, Crockett, & Kellam, 1994). It is also possible that poor reading and separation anxiety exacerbate each other (Grills-Taquechel et al., 2012). For instance, it is possible that children with poor reading develop an aversion to school and prefer the comfort of home, which lowers their attendance rate at school and reduces reading practice and simultaneously increases concerns about being away from their home and parents. Thus, poor readers with separation anxiety may be unable to cope with their difficulty in learning to read, which leads poor readers to avoid practicing reading, and hence maintains their anxiety.

Why might poor reading be associated with generalized anxiety? Firstly, it is possible that poor reading causes generalized anxiety. Poor readers consider reading to be a stressful task and symptoms of generalized anxiety (i.e., feeling overwhelmed and worried) may be exacerbated because of this stress, which manifests when poor readers are asked to read (Thomson, 1996). This is supported to some extent by research that has shown that children with learning disabilities experience high levels of "non-specific general anxiety" (Li & Morris, 2007; Raghavan, 1998). Alternatively, generalized anxiety might cause poor reading because children worry about failing and have difficulty concentrating on reading tasks because of excessive worry (Normandeau & Guay, 1998; Elliot & McGregor, 1999). Thus, poor readers may have difficulty engaging in reading because of their generalized anxiety. Finally, as with separation anxiety, it is also possible that generalized anxiety and poor reading exacerbate each other (Grills-Taquechel et al., 2012). Thus, poor readers with generalized anxiety may experience stress and poor concentration that leads children to avoid reading and maintains their anxiety.

Thirdly, why might poor reading be associated with trait anxiety? It is possible that trait anxiety causes poor reading. Children with trait anxiety may be distracted by their worries that make it difficult for children to concentrate and engage with complex tasks such as reading. Other studies have found a similar association between trait anxiety and children's mathematics performance, as well as children with learning disabilities (e.g., Bertrams, Englert, Dickhauser, & Baumeister, 2013; Margalit & Shulman, 1986). Alternatively, the association between poor reading and trait anxiety may be a result of how trait anxiety is measured. All studies included in this review measured trait anxiety with the State-Trait anxiety Inventory (STAI; Spielberger et al., 1983), which has poor specificity and strong correlation with generalized anxiety. Research suggests that trait anxiety is strongly correlated with generalised anxiety, and this suggests that the symptoms of these two anxiety disorders may represent a similar phenomenon. In other words, measures that assess the symptoms of trait anxiety and generalised anxiety may be measuring symptoms of generalised anxiety (Grupe & Nitschke, 2013; Nitschke, Heller, Imig, McDonald & Miller, 2001; Watson, Weber, Assenheimer, Clark, Strauss, & McCormick, 1995). As a way forward, future research may attempt to measure trait anxiety with multiple measures to elucidate the relationship between trait anxiety and poor reading.

Unlike anxiety, this review found inconsistent evidence for an association between poor reading and depression. This outcome conflicts with one previous review that found an association between poor reading and depression (Mugnaini et al., 2009), but accords with another review that also found mixed evidence for such an association (Maughan & Carroll, 2006). The discrepancy between the outcomes of Mugnaini et al., Maughan and Carroll, and the current review might be explained by how depression was measured. Mugnaini et al. included studies that measured the association between poor reading and depression, as well as poor reading and internalizing behaviour, and only reported studies

that found an association between poor reading and depression or internalizing behavior. For instance, one study found an association between poor reading and anxiety (Carroll et al., 2005) – reported in the Mugnaini et al. review - but no association between poor reading and depression – not reported in the Mugnaini et al. review. Thus, Mugnaini et al. may have found a supposed link between poor reading and depression because they (1) included studies that measured internalizing behavior as well as depression, and (2) failed to report non-significant associations between poor reading and depression, which were both addressed in the reviews by Maughan and Carroll and the current review.

Aim 2: What characterizes the subgroup of poor readers who suffer from anxiety or depression

Having identified a potentially reliable association between poor reading and anxiety, we attempted to delineate the characteristics of poor readers with symptoms of anxiety. To this end, we compared studies that did and did not find an association between poor reading and anxiety for type of anxiety, age, sex, type of school, type of reading impairment, and level of attention. Poor reading was associated with symptoms of separation anxiety, generalized anxiety, and trait anxiety. There was also indirect evidence suggesting that sex may moderate the association between poor reading and anxiety, possibly with this association being more prevalent in males than females. In contrast, the association between poor reading and anxiety does not appear be moderated by participant's age or their type of reading impairment. Unfortunately, there was too little direct or indirect evidence to determine if the association between poor reading and anxiety was moderated by type of school attended.

Regarding inattention, five out of six studies that found an association between poor reading and anxiety also controlled for attention statistically. This argues against the idea that only poor readers with poor attention are likely to have anxiety. It also contrasts with the results of a previous review that found ADHD characterizes poor readers and

their emotional outcomes (e.g., Mugnaini et al., 2009). The discrepancy between the outcomes of Mugnaini et al. and the current review might be explained by the samples and analyses of the studies included. Mugnaini et al. did not specify whether the studies included in the review (1) did not report whether or not poor readers had poor attention, or (2) controlled for poor attention statistically. The current review included both the aforementioned criteria when selecting studies. Thus, Mugnaini et al. may have found an association between poor readers, internalizing and attention because they did not consider differences between studies that did or did not control for attention.

Limitations, future research and clinical implications

A number of methodological limitations were identified in the studies included in this review. First, many studies failed to report information for key variables that are associated with poor reading and poor emotional health including age, sex, school system, and attention. This has important implications for interpreting the results from these studies and may obscure the true association between poor reading and anxiety or depression. It would be helpful if future studies reliably measure and report the aforementioned variables.

Second, there was little consistency between studies regarding how depression was measured. The most common index of depression used in the depression studies was the Child Depression Inventory (CDI; Kovacs, 1985). However, this was only administered in three studies. Variation in how depression was measured between studies may partially explain the unclear association between poor reading and depression in the studies reviewed. However, this does not entirely explain the unclear association, as various measures were also used to assess anxiety (see below). Nonetheless, it would be useful if the CDI were administered in future studies, or an equally reliable and valid measure of depression, to enable results from the same measure of depression to be comparable between studies.

There was also little uniformity between studies in how anxiety was measured. Fourteen different anxiety measures were administered in the 14 anxiety studies. From these studies, the Multidimensional Anxiety Scale for Children (MASC; March, 1997) was the most common measure, but this was administered in only two studies. The symptoms of anxiety outlined in the DSM-V were assessed in many studies, but not all symptoms of anxiety were measured (e.g., selective mutism, panic disorder, agoraphobia, and generalized anxiety disorder). Thus, it would be useful if future studies administered the MASC, or an equally reliable and valid measure of anxiety, to enable the results from the same measure of anxiety to be comparable between studies. Future research may also consider using a diagnostic interview to determine the relationship between poor reading and diagnoses of anxiety. This is important because we still need to understand if the relationship between poor reading and anxiety translates into clinical diagnoses of anxiety disorders. This will help us to better understand the clinical outcomes for poor readers and inform the development of interventions for this subgroup of poor readers.

Fourth, studies used very inconsistent criteria to identify poor readers. While one study attempted to determine whether certain types of poor reading were more closely associated with anxiety (e.g., Grills-Taquechel et al., 2012), no study examined whether certain types of reading difficulty were more closely associated with depression than others. Thus, future studies might consider whether certain types of poor reading are more closely associated with symptoms of anxiety or depression.

Addressing these limitations in future research will help us to better understand the relationship between poor reading and anxiety, and clarify the relationship between poor reading and depression. We also need to gain insight to the causal mechanisms of this relationship. Current theoretical approaches argue that anxiety may lead to poor reading, or that poor reading may lead to anxiety. Alternatively, some suggest that there is a bidirectional association between poor reading and anxiety, such that poor reading and

poor emotional health cause and effect each other (Grills-Taquechel et al., 2012). For example, poor reading may contribute to anxiety (i.e., poor reading leads to negative thoughts and worry about future poor performance) and anxiety may contribute to poor reading (i.e., anxiety about reading leads to avoidance and less reading practice). Poor reading and anxiety both create negative spin-offs, such as less reading practice and worry, which reduce the likelihood of children engaging in reading tasks. As a consequence, poor readers are not likely to improve their reading performance and their anxiety is maintained. While the "reciprocal" theory between poor reading and anxiety is the most likely explanation, further research is needed to understand the theoretical underpinnings of this bidirectional association.

Clarifying the relationship between poor reading and anxiety also has important implications for developing interventions. For instance, informing whether reading training should be administered (1) immediately before anxiety treatment, (2) within the same session, or (3) after anxiety treatment. In support of the first approach, reducing anxiety before reading training may reduce immediate stress associated with reading. Reading training may also provide immediate exposure to reduce poor readers fears. Alternatively, reducing anxiety before commencing reading training may be useful because anxiety and fear of failure may disrupt poor readers ability to learn to read (e.g., Coleman & Vaughn, 2000). However, the optimal timing of anxiety and reading treatment are empirical questions that can only be answered via empirical examination.

Summary

In sum, the aim of this systematic review was to (1) explore whether anxiety or depression was reliably associated with poor reading, and (2) determine what characterizes poor readers who suffer from anxiety or depression. Overall, the results suggest that there is not a reliable association between poor reading and depression. However, poor reading is reliably associated with anxiety, specifically symptoms of generalized and separation

anxiety, as well as trait anxiety. The results also suggest that sex may moderate this relationship between poor reading and anxiety.

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Chapter 3

The Relationship between Poor Reading and Poor Emotional Health

Deanna **Francis** & Genevieve **McArthur**

Macquarie University

Abstract

The aim of this study was to examine the associations between different types of poor reading (e.g., nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of poor emotional health including reading self-concept (perceived reading competence, perceived reading difficulty, reading attitude), anxiety, and depression. We asked 29 poor readers aged between 8- 12 years of age to complete various reading and emotional health measures. We found different aspects of reading were related to different types of reading self-concept, and that poor readers were at greater risk for poor perceived reading competence and poor reading attitudes. We also found that reading comprehension was related to anxiety and depression, and that poor readers were at higher risk for experiencing anxiety and depression. These findings support hypotheses that poor reading is generally associated with poor reading self-concept, anxiety, and depression; and further suggest that these associations are a result of more specific associations between certain types of poor reading and certain types of poor emotional health. We discuss these results in relation to three theoretical models, and suggest numerous ways in which this field of research might move forward to support the needs of poor readers.

The relationship between poor reading and poor emotional health

Introduction

The reading skills of around 16 per cent of primary-school children are below the average range for their age, and five per cent of children have significant, severe, and persistent reading impairments (Ramus, 2001). These reading impairments may include difficulties with phonological decoding (i.e., the ability to read using the letter-sound rules), whole-word or sight-word reading (i.e., the ability to read words from orthographic memory), and reading comprehension (i.e., the ability to understand the meaning of written text). Evidence also suggests that poor readers may have poor spelling, and these impairments may include difficulties with phonological recoding (i.e., the ability to spell words using the letter-sound rules) and whole-word spelling (i.e., the ability to write words from orthographic memory; Brunsdon, Hannan, Coltheart, & Nickels, 2002; Castles & Coltheart, 1993; Castles et al., 2009; Coltheart, Masterson, Byng, Prior, & Riddoch, 1983; Nation, Cocksey, Taylor, & Bishop, 2010).

Poor reading can have a significant negative impact on a child's life in a number of ways. For example, numerous studies have shown that poor reading is associated with low academic achievement (Frauenheim, 1978; Hakkarainen, Holopainen, & Savolainen, 2013; Kiuru, Haverinen, Salmela-Aro, Nurmi, Savolainen, & Halopainen, 2011; Maughan, 1995; Olofsson, Taube, & Ahl, 2015; Spreen, 1987). There is also some evidence that poor reading is associated with some emotional health problems, such as poor self-concept, anxiety, and depression (Chapman & Tunmer, 1995, 1997; Grills-Taquchel et al., 2012, 2013, 2014; Morgan, Farkas, & Wu, 2012; Mamarella et al., 2014). Emotional health encompasses a wide range of feelings and emotions that includes the perceptions, thoughts and beliefs about oneself and the environment. Some of the most common emotional health problems affecting individuals include anxiety (i.e., worry and stress) and

depression (i.e., feelings of sadness and withdrawal). However, this evidence is not as extensive, as reliable, or as well understood theoretically, as the evidence for an association between poor reading and poor academic achievement. Thus, the aim of the current study is to improve our understanding of the relationships that might exist between poor reading and poor self-concept, anxiety, and depression in poor readers.

Self-concept

Self-concept is a multidimensional construct that refers to the thoughts, perceptions, beliefs and evaluations that one holds about oneself (i.e., "I am a good person" or "I am good at my job"). Self-concept is related to emotional health because it can impact how an individual feels about himself or herself. For example, an individual with negative self-concept may hold negative beliefs (i.e., I am a terrible person) and these beliefs impact their emotional well-being and behaviour. These perceptions tend to develop through experience and interaction with the environment during childhood (Harter, 1990; Shavelson, Hubner, & Stanton, 1976). While there are many different types of selfconcept, academic self-concept has received substantial empirical study. Academic selfconcept refers to an individual's self-perceptions about their ability and performance in academic subjects (Marsh, Hau, & Kong, 2002; Marsh & Koller, 2004; Marsh & Martin, 2011; Marsh, Walker & Debus, 1996). Research suggests that academic self-concept is associated with academic motivation and as well as behavioral, emotional, and cognitive outcomes, and there is a growing body of evidence to support a reciprocal association between academic self-concept and achievement outcomes (Marsh et al., 2002; Marsh & Koller, 2004; Marsh & Martin, 2011; Moller, Retelsdorf, Koller, & Marsh, 2011; Parker, Marsh, Ciarrochi, Marshall, & Abduljabbar, 2014). This evidence has consistently revealed poor academic self-concept in poor readers compared to typical readers (Chapman, 1988; Hansford & Hattie, 1982; Polychroni, Koukoura, & Anagnostou, 2006;

Zeleke, 2004). Considered together, these results suggest that poor reading is associated with poor academic self-concept.

As well as examining academic self-concept in poor readers, researchers have tested a subtype of academic self-concept - reading self-concept - in poor readers (Chapman & Tunmer, 1995, 1997). Reading self-concept is thought to develop during the early school years when children are beginning to read (Chapman & Tunmer, 1995, 1997; Marsh, Smith, & Barnes, 1985). According to Chapman and Tunmer's model of reading self-concept, there are three components of reading self-concept: perceptions of competence (i.e., beliefs about reading ability), perceptions of difficulty (i.e., beliefs that reading activities are difficult) and attitudes toward reading (i.e., feelings toward reading; Chapman & Tunmer, 1995, 1997). To our knowledge, seven studies have reported low reading self-concept in readers with low overall reading achievement (Chapman & Tunmer, 1995, 1997; Chapman, Tunmer, & Prochnow, 2000; Conlon, Zimmer-Gembeck, Creed & Tucker, 2006; Retelsdorf et al., 2011, 2014; Wilson, Chapman, & Tunmer, 1995). In contrast, two studies have found mixed evidence for an association between poor reading self-concept and poor reading (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Forster & Souvignier, 2014); and, somewhat inexplicably, one study has reported inflated reading self-concept (specifically, inflated perceived reading competence) in poor readers (Fives et al., 2014). Thus, the evidence to date supports an association between poor reading and poor self-concept in poor readers. However, this evidence is both limited in magnitude and somewhat contradictory.

Anxiety

Anxiety is an internalizing disorder characterized by excessive fear or worry (American Psychiatric Association, 2013). Anxiety disorders tend to emerge during childhood (Kessler, Berglund, Demier, Jin, Merikangas, & Walters, 2005) and commonly affect 6.9% of children and adolescence (Ford, Goodman, & Meltzer, 2003). In terms of

the different types of anxiety disorders, the most common anxiety disorders among children include separation anxiety (Briggs-Gowan, Horwitz, Schwab-Stone, Leventhal, & Leaf, 2000; Costello, Mustillo, Erkanli, Keeler, & Angold 2003), generalized anxiety, social anxiety, and specific phobias (Breton, Bergeron, Valla, Berthiaume, & Gaudet, 1999). According to prominent cognitive theories of anxiety, negative appraisal, cognitive errors, and avoidance (fear of fear) contribute to the development and maintenance of anxiety disorders (Beck & Emery, 1985; Ehlers & Clark, 2000; Foa & Kozak, 1986). For instance, cognitive errors might include generalization (i.e., "I got 5/10 on my spelling test – I'm terrible at everything"), catastrophization (i.e., "I got 5/10 on my spelling test – I'm going to fail school") and mind reading (i.e., "everyone thinks I'm stupid). These cognitive errors may lead poor readers to avoid reading because they worry about future negative outcomes, and thus, poor readers have limited opportunity for evidence contradictory to their fears (i.e., no one laughs when I read). In other words, these cognitive processes and negative thoughts may lead to symptoms of anxiety. These symptoms might include worry, stress and avoidance as well as maladaptive thoughts (i.e., I will perform poorly) or behaviours (i.e., constant checking or ordering).

Approximately 17 studies have explored the relationship between anxiety and poor reading. Most of these studies have reported an association between anxiety and poor reading or higher rates of anxiety in poor readers compared to typical readers (Arnold et al., 2005; Bonifacci, Montuschi, Lami, & Snowling, 2014; Carroll, Maughan, Goodman, & Meltzer, 2005; Carroll & Illes, 2006; Goldston et al., 2007; Grills-Taquechel, Fletcher, Vaughn, & Stuebing, 2012, 2013; Mammarella et al., 2014; Nelson, Lindstrom, & Foels, 2013; Undheim, 2003; Willcutt & Pennington, 2000). In contrast, three studies have failed to report an association between anxiety and poor reading, or found no difference in anxiety between poor and typical readers (Boetsch, Green, & Pennington, 1996; Miller, Hynd, & Miller, 2005; Nelson & Gregg, 2012). Thus, at this stage of research, more

studies suggests that there is an association between poor reading and anxiety. However, as is the case for reading self-concept, this evidence is somewhat mixed.

Depression

Depression is also an internalizing disorder that includes features of depressed mood, loss of interest in activities, as well as symptoms of sadness, irritability, fatigue and sleep disturbance that impair an individuals capacity to function efficiently (American Psychiatric Association, 2013). Depression tends to emerge after anxiety disorders, and affects around 0.3- 1.4% of preschool children and 1- 2% of pre-adolescent children (Egger & Angold, 2006; Stalets & Luby, 2006). The incidence of depression increases after pre-adolescence, with depression affecting approximately 3-8% of adolescents (Birmaher et al., 1996; Lewinsohn et al., 1994).

Most cognitive theories of depression suggest biased cognitive processes play a crucial role in the development and maintenance of depression (i.e., negative "self schemas"; Beck, 1967). These thought processes may involve negative beliefs about oneself, negative beliefs about the world, and negative beliefs about the future (the "cognitive triad"; Beck, 1987). For instance, a poor reader might attribute their poor performance to a problem within oneself (i.e., "It's my fault I can't read"), generalize this failure to other areas (i.e., "I got 5/10 on my spelling test – I'm terrible at everything"), and consider failure likely to occur again in the future (i.e., "I will never pass my spelling test"). These thoughts demonstrate a pattern of internal, global and stable negative cognitive processes that may lead to feelings of hopelessness and, thus, depression (Braet, Wante, Van Beveren, & Theuwis, 2015; Lamberton & Oei, 2008; Muris & van der Heiden, 2006). In other words, these thought processes lead to symptoms of depression. These symptoms might include behaviors and thoughts related to sadness (i.e., I can't read as well as my classmates), hopelessness (i.e., I will never learn to read) and loneliness (i.e., withdrawal from reading activities.

Evidence for an association between depression and poor reading appears to be more inconsistent than for an association between anxiety and poor reading. Some studies report an association between poor reading and depression, or a higher incidence of depression in poor readers compared to typical readers (Arnold et al., 2005; Daniel, Walsh, Goldston, Arnold, Reboussin, & Wood, 2006; Maughan, Rowe, Loeber, & Stouthamer-Loeber, 2003; Mammarella et al., 2014; Morgan, Farkas, & Wu, 2012; Willcutt & Pennington, 2000), while others fail to report an association between depression and poor reading, or report no difference in the incidence of depression between poor and typical readers (Boetsch et al., 1996; Bonifacci et al., 2014; Carroll et al., 2005; Miller et al., 2005; Nelson & Gregg, 2012; Undheim, 2003). Thus, given the current state of the literature, the evidence for an association between depression and poor reading is somewhat limited in amount, as well as clearly equivocal.

Reading and spelling

When reviewing the literature of the association between poor reading and self-concept, anxiety, and depression, one is struck by the many different ways that poor reading is identified. For example, in some studies, poor readers are recruited via poor performance on word or nonword reading accuracy or fluency (Grills-Taquechel et al., 2012, 2013; Goldston et al., 2007; Carrol & Illes, 2006; Arnold et al., 2005; Mammarella et al., 2014; Nelson & Gregg, 2012; Wilcutt & Pennington, 2000), in some studies by poor reading comprehension (Arnold, 2005; Grill-Taquechel et al., 2013; Morgan et al., 2012; Nelson & Gregg, 2012), and in some studies by poor spelling (Boetsch et al., 1996; Carroll et al., 2003; Wilcutt & Pennington, 2000). In some respects, this "mixed" approach is appropriate because poor readers are a heterogeneous group of people who have very different patterns of reading weaknesses. However, in terms of scientific methodology, such a mixed approach is undesirable because it obscures whether some types of reading

impairment are more closely associated with some types of emotional health problems than others. For example, it is possible that a child with good reading accuracy, but poor reading comprehension, may be able to mask their reading difficulty more easily from their teacher and their peers than a child with poor reading accuracy, and hence may avoid developing poor reading self-concept and anxiety. Thus, when understanding the association between poor reading and poor emotional health, it may be important to understand the separate relationships between different types of reading problems and reading self-concept, anxiety, and depression.

Aims

As outlined above, the evidence to date suggests that (1) poor reading may be associated with poor reading self-concept; (2) there may be an association between poor reading and anxiety; and (3) it is not yet clear if there is an association between poor reading and depression. It is also not yet known if some types of reading difficulties are more closely related to problems with self-concept, anxiety, or depression, than other types of reading difficulties, since this has never been tested before. The aim of the current study, therefore, was to examine the relationships between different types of poor reading and spelling (e.g., nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of reading self-concept (perceived reading competence, perceived reading difficulty, reading attitude), anxiety, and depression. We measured different types of spelling as well as reading since poor readers often have trouble with spelling as well as reading, and since some spelling tests are more sensitive to mild or residual reading difficulties than reading tests (Lindgren & Laine, 2011).

We addressed our aim in two ways. First, in a sample of poor readers we measured how closely individuals' different reading and spelling scores were correlated with their different reading self-concept, anxiety and depression scores. Second, for those reading

self-concept, anxiety and depression measures that were reliably related to reading or spelling, we calculated the percentage of poor readers with atypical scores compared to a typical population. This second step was necessary because correlations are relative rather than absolute. Thus, even if a strong correlation existed in poor readers between, say, poor word reading accuracy and anxiety, this would not necessarily mean that poor word readers had high levels of anxiety.

Based on previous (albeit limited and mixed) findings, we predicted that poor reading would be associated with at least one type of poor reading self-concept, and that poor reading would be associated with higher levels of anxiety. It was not possible to predict if poor reading would be associated with depression due to the mixed nature of the existing evidence. Likewise, it was not possible to predict which types of poor reading would be associated with poor reading self-concept, anxiety, or depression, since this has never before been tested empirically.

Methods

Ethics statement

The methods used in this study were approved by the Macquarie University Human Ethics Committee (Ref: 5201500286). With their parent or guardian's consent, participants received $10 for their time. Parents and guardians were given an individualised report detailing the results of the assessment for their child.

Participants

Children were recruited via the Macquarie University Cognition Clinic for Reading (N = 5) and through online advertisements via the Clinic Facebook page and Neuronauts register (https://www.ccd.edu.au/services/neuronauts/; N = 40). They were included in the study if they (1) were aged from 96 to 144 months (8 to 12 years); (2) scored at least 1 standard deviation (*SD)* below the mean for their age on at least one measure of reading or

spelling (see measures below); (3) had no history of neurological or sensory impairment, previous psychiatric diagnosis, or history of ADHD as indicated on a background questionnaire (see Appendix D); and (4) used English as their primary language. Children were also tested for their verbal and non-verbal intelligence to inform our understanding of our sample. However, no children were excluded based on their IQ scores since intelligence does not reliably predict reading ability (Gresham & Vellutino, 2010).

The responses by the parents or guardians of the 45 participants in the background questionnaire revealed that two participants had a previous diagnosis of ADHD. These children were excluded from the study; hence, 43 children completed the reading and emotional health assessments. Fourteen children did not perform more than one *SD* below the mean age for their age on any reading or spelling tests, and hence were also excluded.

The final sample included 29 children with scores at least one *SD* below age or grade mean on at least one reading or spelling measure (see Table 1 for means and *SDs* of the reading and emotional-health measures). These children were aged between 96 and 144 months (8 year and 0 months to 12 years and 0 months), with a mean age of 121.28 months (*SD* = 15.75; 10 years and 1 month). There were 13 female and 16 male participants. All participants attended mainstream schools, with students attending grades 2 to 6 (*M*=4.21, *SD*=1.23). Poor readers also had average intelligence across their verbal (*M*=92.64, *SD*=11.10) and nonverbal abilities (*M*=103.14, *SD*=17.29). All participants had English as their primary language, and all met the previously described exclusion criteria.

Table 1

Means and standard deviations for poor readers and typical populations on reading and emotional measures

	Poor Readers			Typical Population	
	M	SD	*N*	M	SD
Nonword Reading	80.02	11.96	29	100	15
Irregular Reading	82.02	13.46	29	100	15
Reading Comprehension	85.52	20.39	29	100	15
Nonword Spelling	72.69	9.44	29	100	15
Irregular Spelling	85.10	19.45	29	100	15
Nonverbal IQ	103.14	17.29	29	100	15
Verbal IQ	92.64	11.10	29	100	15
Reading Self-Concept Total	3.10	0.48	28	3.74	0.56
Perceived Reading Difficulty	3.11	0.86	28	3.29	0.81
Perceived Reading Competence	2.98	0.77	28	3.75	0.74
Reading Attitude	3.21	0.90	28	4.19	0.76
Anxiety Total	103.72	19.45	29	100	15
Depression	8.52	5.92	29	4.68	4.66

Assessments

Children completed the reading and/or emotional health measures at Macquarie University in a quiet testing room with a trained reading assessor (the first author). Children recruited via online advertisements completed the reading and emotional health measures in a 2-hour session. Children recruited via the Clinic had been administered the reading measures within the previous 9 months, and hence only had to complete the emotional health measures within a 1-hour session.

Reading and spelling measures

Nonword and irregular word reading accuracy. We measured phonological decoding and whole-word reading using the Nonword and Irregular Word subtests of the Castles and Coltheart Test (CC2; Castles, Coltheart, Larsen, Jones, Sauders, & McArthur, 2009). The CC2 Nonword Subtest assesses the ability of children aged 6- 12 years to use letter-sound rules to read aloud nonwords (e.g., "SPATCH"). The CC2 Irregular Word Subtest assesses reading accuracy for words that cannot be read accurately using the lettersound rules alone (e.g., "YACHT"). The CC2 also includes a Regular Word Subtest. We did not use scores for this subtest because it is a combined measure of both phonological decoding and whole word recognition, and we wished to index these two reading abilities separately.

The CC2 presents children with 40 nonwords, 40 regular words, and 40 irregular words in a semi-random order that increases in difficulty (e.g., nonword 1, regular word 1, irregular word 1, irregular word 2, regular word 2, nonword 2). The presentation of any word type (e.g., nonwords) is stopped after 5-consecutive errors in the relevant word list (i.e., nonword list). Each item is marked as correct (1) or incorrect (0). The number of correct items is summed, and then converted into a standardised *z*-score that has a mean of 0 and SD of 1, which we converted into standardised scores that had a mean (*M*) of 100 and *SD* of 15 (we carried out this conversion for all the reading and spelling tests to allow direct comparison of children's performance on different reading and spelling measures). Moore, Porter, Kohnen, and Castles (2012) have reported that the Cronbach's alpha for the nonword subtest is .94, and .86 for the irregular word subtest.

Reading fluency. We tested phonological decoding fluency and whole word reading fluency using the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999). The TOWRE comprises two subtests that measure reading rate for nonwords and for "sight words" (a mix of high frequency regular and irregular words). In

both subtests, children are asked to read as many nonwords as quickly as they can in 45 seconds. The sight word test measures lexical access, and children read as many irregular and regular words as quickly as they can for 45 seconds. The test is designed for children aged 6- 12 years.

Each item is marked as correct (1) or incorrect (0). Children's scores in each subtest are derived by calculating the total number of words read correctly out of 63 for the nonword reading fluency test, and out of 104 for the sight word reading fluency test. These total scores are used to calculate standard scores that have a mean of 100 and *SD* of 15. The TOWRE has good test-retest reliability and construct and criterion validity, with estimates greater than α = .90 (Torgesen et al., 1999).

Reading comprehension. Reading comprehension was measured using the Test of Everyday Reading Comprehension (TERC; McArthur, Jones, Anandakumar, Larsen, Castles, & Cotlheart, 2013). This comprises 10 pictorial items of everyday reading material (e.g., a shopping list or a text message). After examining each item, children are asked two literal questions (i.e., 20 questions in total) based on the text presented in each item (e.g., “What kind of bread do you need to buy?” and “How much milk do you need to buy?”). Testing is stopped when a child makes 6 incorrect responses within 3 stimuli. Each item is marked as correct (1) or incorrect (0). The number of correct items is summed, with a maximum possible score of 20, and then converted into a standardised *z*-score that has a mean of 0 and SD of 1. We converted these scores into standardised scores that had a mean of 100 and *SD* of 15. The test was designed for children aged 6- 12 years.

The TERC has good inter-rater reliability (*r*=.99), and alternate-form reliability (*r*=.86) as indicated by the intra-class correlations (McArthur, Jones, Anandakumar, Larsen, Castles, & Coltheart, 2013). There is also preliminary evidence indicating sound validity estimates with strong correlations reported between the TERC and tests of spoken

word reading (*r*=.75), Neale reading accuracy (*r*=.74) and Neale reading comprehension (*r*=.71; Wheldall & McMurtry, 2014).

Irregular spelling. The Diagnostic Spelling Test for Irregular Words (DiSTi) is a test of children's irregular word spelling (Kohnen, Colenbrander, & Nickels, 2012). The DiSTi consists of 74 items that contain at least one ambiguous or irregular sound-letter mapping (e.g., "LAUGH"). For each item, the examiner reads a word aloud, presents the word in a sentence, and then repeats the word one more time. The child then spells the word. The test is stopped after five consecutive errors.

Each item is marked as correct (1) or incorrect (0). The number of correct items is summed, with a maximum possible raw score of 74, and then converted into a standardised *z*-score that has a mean of 0 and *SD* of 1. We converted these scores into standardized scores that had a mean of 100 and *SD* of 15. The DiSTi has good internal consistency ($\alpha = 0.94$) and test-retest reliability (r_s=0.96), as well as sound construct validity (r=0.61; Kohnen, Colenbrander, Krajenbrink, & Nikels, 2015).

Nonword spelling. The Nonword Spelling subtest of the Queensland Inventory of Literacy (QUIL) assesses children's sound-letter knowledge (Dodd, Holm, Oerlemans, & McCormick, 1996). The QUIL comprises 24 nonwords that are presented in order of difficulty (e.g., "STRIMPERDICTION"). The examiner reads each nonword twice. The child then spells the nonword.

Each item is marked as correct (1) or incorrect (0). The number of correct items is summed, with a maximum possible raw score of 24, and then converted into scaled scores that have a mean of 10 and *SD* of 3. We converted these scores into standardised scores that had a mean of 100 and *SD* of 15. The QUIL is reported to have sound concurrent validity, but no estimates are provided in the literature due to the subjective nature of scoring (e.g., Health et al., 2014). There are also no available estimates of split-half reliability but an inter-rater reliability of 94% has been cited (Dodd, Holm, Oerlemans, &

McCormick, 1996)

Emotional health measures. Children completed the three pen and paper emotional health measures in an individualised testing situation. Because all children were poor readers, the assessor read each item of the emotional health questionnaires to children so they did not have to read the items themselves. Children indicated their responses by saying a number (e.g., “number 3”) or by reading a very simple written descriptor (e.g., "not at all"). Children were given examples of how they could respond, and they could see the possible responses while completing the questionnaire. All children were able to answer the questions and found this to be a relatively simple task. Some children asked for a reminder of the number and written descriptor, while others were able to remember the written descriptors with ease. This is consistent with studies that show poor readers can use their short-term memory recall simple visual information, including small amounts of written text (Hachmann, Bogaerts, Szmalec, Woumans, Duyck & Job, 2013). The examiner sat next to the children and circled the response sheet as the child answered each question in turn.

Reading self-concept. Reading self-concept was measured using the Reading SelfConcept Scale (RSCS; Chapman & Tumner, 1995). The RSCS comprises 30 questions that assess perceptions of reading difficulty (e.g., “Reading to the class is hard for me”), perceptions of competence in performing reading tasks (e.g., “I’m good at correcting mistakes in reading”), and reading attitudes (e.g., “I like reading to Mum or Dad”). The items are presented in random order. For each statement, children respond on a five-point scale (“1 = no, never”, “2 = no, not usually”, “3 = undecided or unsure”, “4 = yes, usually”, “5 = yes, always”). The undecided or unsure response allows children to show that they understand the question but are unable to select a definite response. This measure took approximately 15 minutes to complete.

Each item is scored according to the five-point scale. The items are summed with a maximum possible raw score of 150. For each subscale, the scores of 10 items were summed and the mean-value calculated. Chapman and Tunmer (1995) report means and *SDs* for children's responses on the perceived reading difficulty, perceived reading competence, and reading attitude subscales as well as the reading self-concept total score. We calculated scores 1 *SD* below the mean and used these as cut-off points to indicate atypical reading self-concept.

The RSCS has sound internal reliability for perceived reading difficulty (α = .70 to .80), perceived reading competence (α = .63 to .82), and reading attitude (α = .79 to .81), as well as overall reading self-concept (α =.84; Chapman & Tunmer, 1995).

Anxiety. Children's anxiety was measured using the Spence Children's Anxiety Scale (SCAS; Spence, 1998). The SCAS is an aged normed test and comprises 45 questions about children's perception of how often they experience symptoms of anxiety. There are six subscales: obsessive-compulsive disorder (e.g., "I have to keep checking that I have done things right – like the switch is off, or the door is locked"), separation anxiety (e.g., "I worry about being away from my parents"), social phobia (e.g., "I worry what other people think of me"), panic/agoraphobia (e.g., "I suddenly become dizzy or faint when there is no reason or this"), generalized anxiety/overanxious disorder (e.g., "I worry about things"), and fears of physical injury (e.g., "I am scared of being in high places or lifts"). There are also five positive items to reduce negative response bias (e.g., "I am a good person"). For each statement, children rate how often the experienced symptoms of anxiety ("0 = never", "1 = sometimes", "2 = often", "3 = always"). This measure took approximately 10 minutes to complete.

Each item is marked with a score from 0 to 4. The number of correct items is summed, with a maximum possible raw score of 120 (excluding the five positive worded questions) and converted to T-scores with a mean of 50 and a SD of 10. Scores were

compared to normative data, with a T-score at or above 60 showing elevated symptoms of anxiety. High scores reflect greater symptoms of anxiety.

The SCAS has high split half reliability (α =.92), sound internal consistency of each subscale (α >.60). Convergent validity is also strong (r=.75; Spence, Barrett, & Turner, 2003).

Depression. Depression was measured using the short mood and feelings questionnaire (SMFQ; Angold, Costello, Messer, Pickles, Winder, & Silver, 1995). The SMFQ comprises 13 items that assess symptoms of depression (e.g., "I felt so tired I just sat around and did nothing"). For each statement, children rate how often they experienced symptoms of depression over the past two weeks ("0 = never", "1 = sometimes", "2 = always"). This measure took approximately 10 minutes to complete.

Each item is marked with a score from 0 to 2. All items are summed, with a maximum possible raw score of 26. Only children's raw scores were examined. The SMFQ is not an age normed test. Rather a clinical cut-off score of 11 and above has been used to indicate the depressive symptoms. This cut-off point has been shown to represent the 94th percentile in a community based sample (i.e., the poorest 6%; Angold et al., 2002).

The SMFQ has sound internal reliability (α =.90) and sound criterion validity with a high correlation with the Children's Depression Inventory (r=.67); and is also able to discriminate between clinical and non-clinical samples (Angold et al., 1995; Sharp, Goodyer, & Croudace, 2006).

Results

Normality

We analysed the data in three steps. First, we assessed the data for normality using the Shapiro-Wilks tests (with an alpha level of < .05), as this is the most robust test of normality given our small sample size (N<50; Elliott & Woodward, 2007; Thode, 2002). All datasets were normally distributed with three exceptions - reading comprehension

(W=.90, *p*=.02), nonword spelling (W=.89, *p*=.01) and depression (W=.90, *p*=.02) – which all had scores skewed towards the lower (poor) end of the distribution. For the normally distributed datasets, the Shapiro-Wilks tests produced values ranging from W=.93 to W=.98, and *p* values ranging from *p*=.07 to *p*=.82.

Minimising variables

The aim of the second step of the analysis was to minimise the number of variables included in the final analyses to reduce Type 1 errors in the subsequent analyses. Using Pearson r correlation coefficients (which are robust to minor violations of normality such as those outlined above; Edgell & Noon, 1984), and an alpha level of < .05, we examined the strength of the relationships between the subscales and the total scores for tests with multiple subscales, including reading self-concept (see Table 2) and anxiety (see Table 3). In line with Cohen (1998), we considered Pearson r correlation coefficients to be small, moderate, or large if they were 0.1, 0.3, and 0.5 respectively.

We discovered that the subscales and total scores of the anxiety test were all strongly interrelated. This suggested that performance on the anxiety test could be represented by a total score alone. In contrast, the subscales of the reading self-concept test were not interrelated (although each was strongly related to the total score). Thus, we represented reading self-concept simply using the three separate subscales (perceived reading difficulty, perceived reading competence, reading attitude) as well as the total score (reading self-concept). This left us with six emotional measures: perceived reading difficulty, perceived reading competence, reading attitude, reading self-concept, anxiety, and depression.

Table 2

Pearson correlations for the subscale and total scores for reading self-concept

	Perceived Reading Difficulty	Perceived Reading Competence	Reading Attitude	Reading SelfConcept
Perceived Reading Difficulty	1			
Perceived Reading Competence	-.29	1		
Reading Attitude	-.01	.25	1	
Reading Self-Concept	.42*	.51**	.75***	1

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3

Pearson correlations for the subscale and total scores for anxiety

	Separation Anxiety	Social Phobia	Obsessive Compulsive	Panic Agoraphobia	Physical Injury Fears	Generalized Anxiety	Anxiety Total
Separation Anxiety	1						
Social Phobia	.62***	1					
Obsessive Compulsive	.56**	.59**	1				
Panic Agoraphobia	.66***	.65***	.72***	1			
Physical Injury Fears	.58**	.52**	.44*	.54**	1		
Generalized Anxiety	.61***	.49**	.55**	.65***	.32	1	
Anxiety Total	.61***	.54**	.65***	.73***	.67***	.56**	1

* $p < .05$, ** $p < .01$, *** $p < .001$

We also used Pearson r correlation coefficients to examine the strength of the relationships between the subscales and total scores of the reading accuracy, reading fluency, reading comprehension, nonword spelling, and irregular spelling tests (see Table

4). These revealed that the scores for the nonword reading accuracy and nonword reading fluency tests were strongly interrelated, and hence we took the mean of the nonword reading accuracy and nonword reading fluency standard scores to produce a nonword reading composite score. The Pearson r correlations also revealed that the scores for the irregular reading accuracy and fluency tests were strongly interrelated, and hence we also calculated the mean standard scores from these two tests and produced an irregular reading composite score. This left us with five reading and spelling measures: nonword reading, irregular reading, reading comprehension, nonword spelling, and irregular spelling.

Table 4

Pearson correlations for the interrelations between the reading and spelling measures

	Nonword Reading Accuracy	Irregular Reading Accuracy	Nonword Reading Fluency	Irregular Reading Fluency	Reading Comprehension	Nonword Spelling	Irregular Spelling
Nonword Reading Accuracy	1	.56***	.67***	.57**	.32	.30	.53*
Irregular Reading Accuracy		1	.60***	.81***	.54***	.32	.80**
Nonword Reading Fluency			1	.78***	.34	.38*	.64**
Irregular Reading Fluency				1	.48**	.41*	.74**
Reading Comprehension					1	.41*	.56*
Nonword Spelling						1	.38*
Irregular Spelling							1

* $p < .05$, ** $p < .01$, *** $p < .001$

The relationship between poor reading or spelling and reading self-concept

In the third step of the analysis, we used Pearson r correlation coefficients (with an alpha of < .05) to index the strength of the relationships between the different reading and

spelling measures and the different measures of reading self-concept, anxiety, and depression. We analysed the data using only bivariate correlations due to constrictions with our sample size, which was not large enough to control for relationships with other variables. In other words, our sample did not provide enough power to conduct correlations between multiple pairs of variables whilst controlling for numerous other variables.

Reading self-concept. Table 5 illustrates the Pearson r correlation coefficients between the different reading and spelling measures and perceived reading difficulty, perceived reading competence, reading attitude, and reading self-concept scores. Figures 1 to 6 illustrate the significant associations between the reading measures (x axis) and perceived reading difficulty, perceived reading competence, or reading attitudes (y axis). Low scores on the x axes indicate poor reading. Low scores on the y axes in figures 5 and 6 indicate poor reading attitudes and poor perceived reading competence, respectively. High scores on the y axes of Figures 1 - 4 indicate high levels of perceived reading difficulty. The dashed line in each figure show the cut-off points that separate typical and atypical scores, as defined in the Methods.

There were statistically significant moderate or large relationships between perceived reading difficulty and nonword reading (r = -.41; see Figure 1), irregular reading (r = -.49; see Figure 2), reading comprehension (r = .51; see Figure 3), and irregular spelling (r = -.45; see Figure 4). There was also a significant moderate relationship between nonword spelling and reading attitude (r = .47; see Figures 5), as well as perceived reading competence (r = .41; see Figure 6). There were non-significant Pearson r correlation coefficients between perceived reading competence, and reading attitude, and all reading and spelling measures, except for nonword spelling. There were non-significant Pearson r correlation coefficients between reading self-concept and all reading and spelling measures.

Table 5

Pearson correlations for reading measures and reading self-concept

	Reading Difficulty	Reading Attitude	Reading Competence	Reading Self-Concept
Nonword Reading	-.41*	.23	.02	-.08
Irregular reading	-.49**	.31	.26	.04
Reading Comprehension	-.51**	.20	.36	.03
Nonword Spelling	-.35	.47*	.41**	.30
Irregular Spelling	-.45*	.28	.13	-.02

* $p < .05$, ** $p < .01$, *** $p < .001$

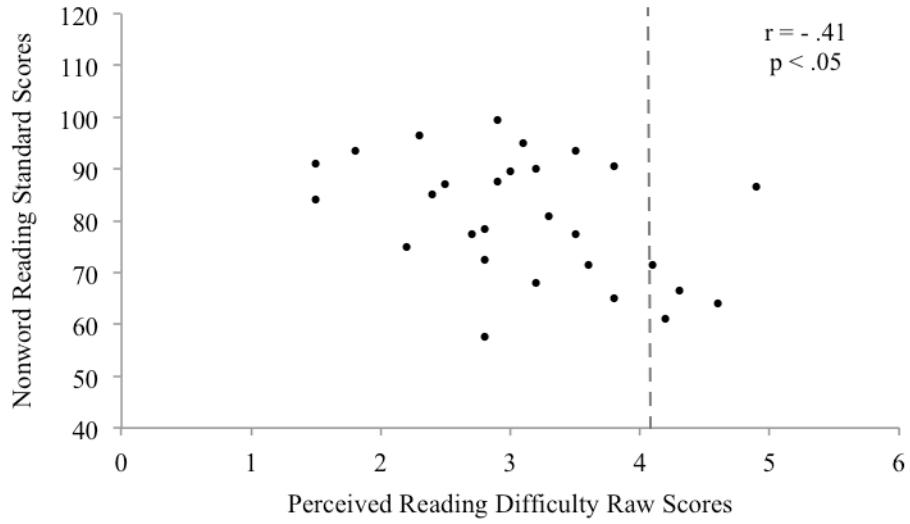

Figure 1. Nonword reading standard scores and perceived reading difficulty raw scores

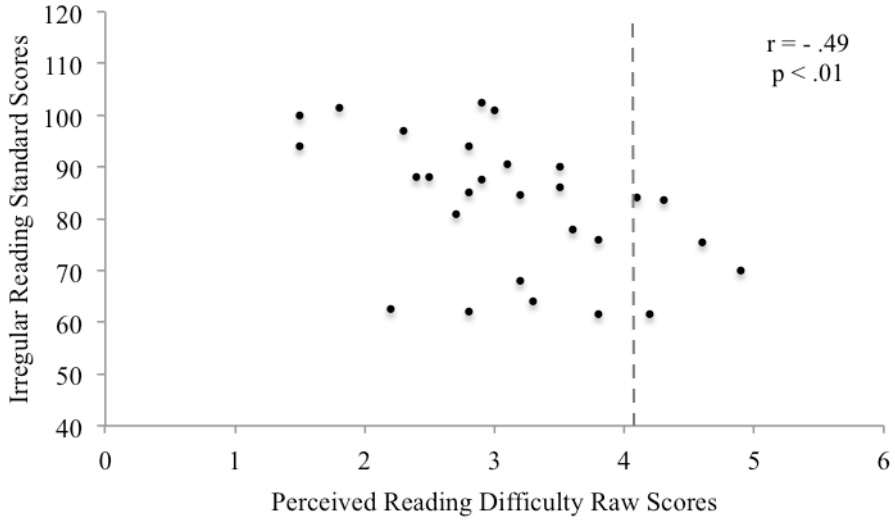

Figure 2. Irregular reading standard scores and perceived reading difficulty raw scores

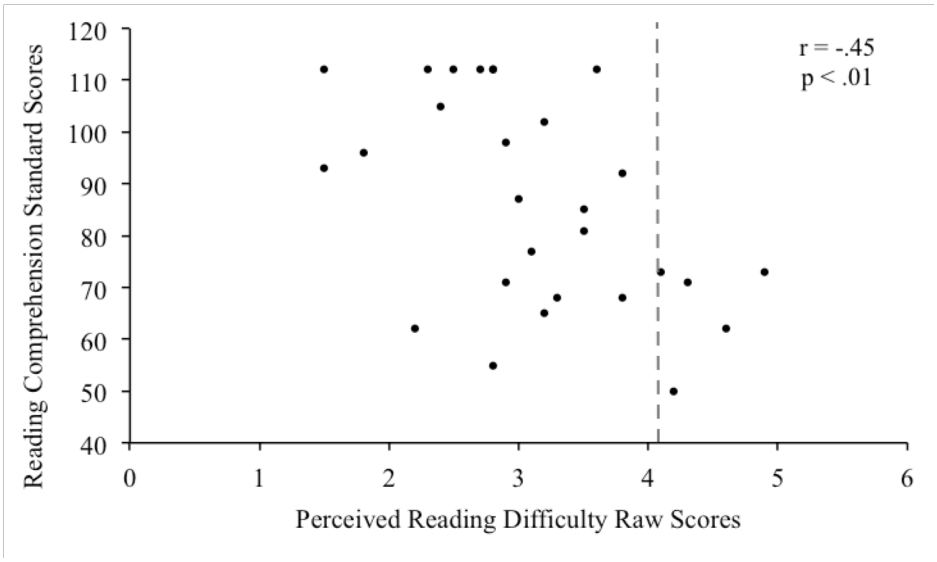

Figure 3. Reading comprehension standard scores and perceived reading difficulty raw scores

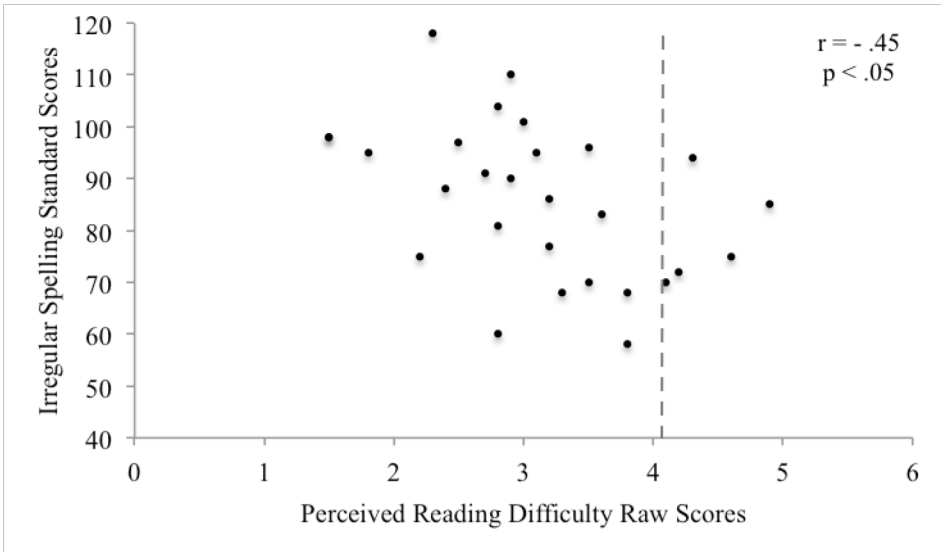

Figure 4. Irregular spelling standard scores and perceived reading difficulty raw scores

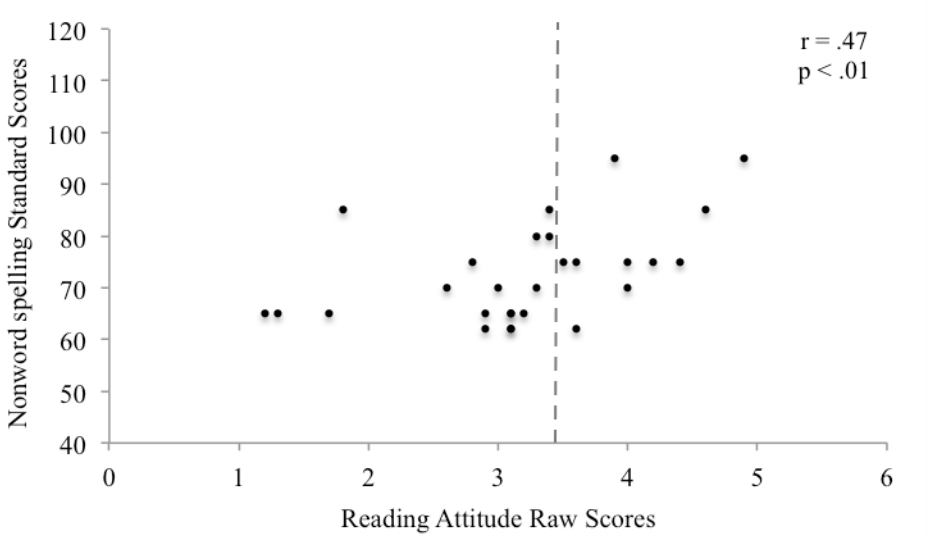

Figure 5. Nonword spelling standard scores and reading attitude raw score

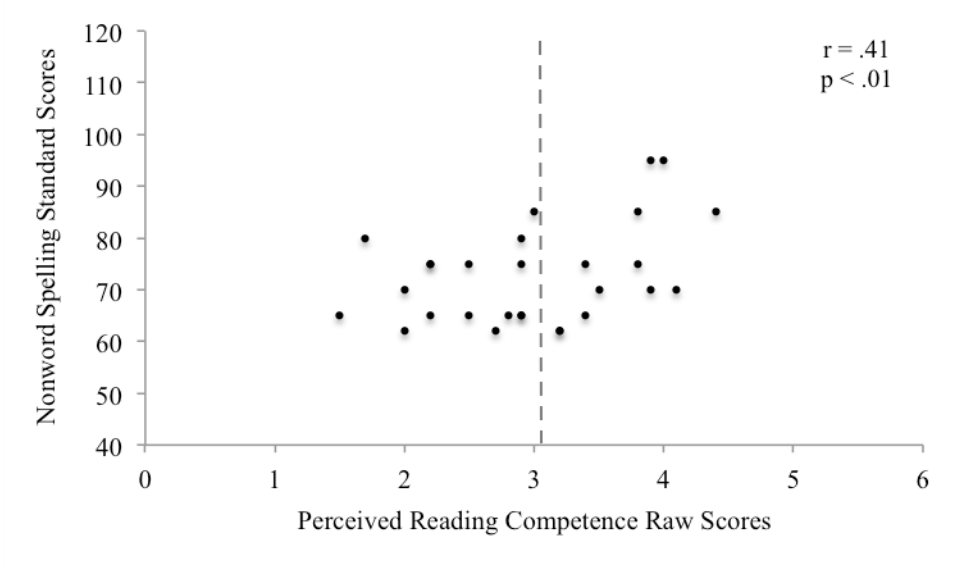

Figure 6. Nonword spelling standard scores and perceived reading competence raw scores

Anxiety. Table 6 illustrates the Pearson r correlation coefficients between the different reading measures and anxiety scores. Figure 7 illustrates the significant association between reading comprehension and anxiety. Low scores on the x axis indicate poor reading comprehension. Low scores on the y axis indicate low levels of anxiety. The dashed line shows the cut-off point that separate typical and atypical scores, as defined in the Methods.

Pearson coefficients showed a significant moderate relationship between reading comprehension and anxiety (r = -.37; see Figure 7). There were no other significant associations between poor reading and anxiety (see Table 6).

Table 6

Pearson correlation coefficients between poor reading and anxiety and depression

	Anxiety Total	Depression
Nonword Reading	-.10	-.34
Irregular Reading	-.14	-.30
Reading Comprehension	-.37*	-.44*
Nonword Spelling	-.14	-.15
Irregular Spelling	-.02	-.15

* $p < .05$, ** $p < .01$, *** $p < .001$

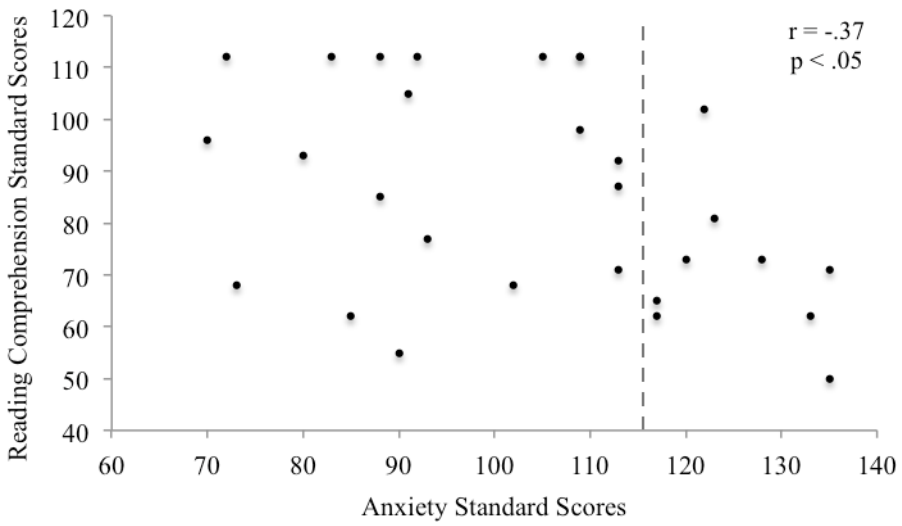

Figure 7. Reading comprehension and anxiety standard scores

Depression. Table 6 illustrates the Pearson r correlation coefficients between the different reading measures and depression scores. Figure 8 illustrates the significant associations between reading comprehension and depression scores. Low scores on the x axis indicate poor reading comprehension. Low scores on the y axis indicate low depression. The dashed line shows the cut-off point that separates typical and atypical scores, as defined in the Methods.

There was a moderate and significant relationship between reading comprehension and depression (r = -.44; see Figure 8). There were no other significant associations between poor reading and spelling and depression (see Table 6).

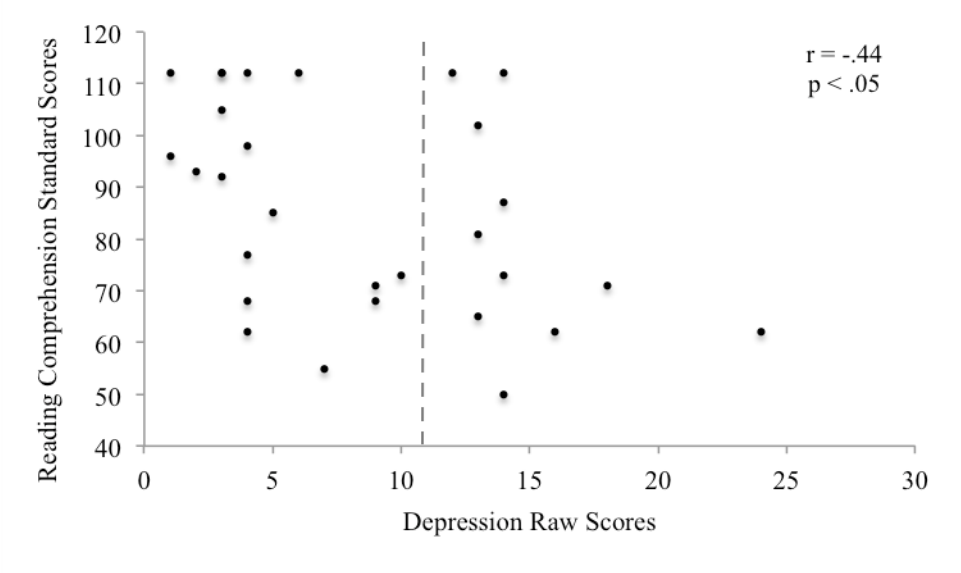

Figure 8. Reading comprehension standard scores and depression raw scores

Risk for atypical scores

In the fourth step of the analysis, we calculated the percentage of poor readers who had scores on the emotional health measures that fell beyond the cut-off points used to define the typical range as outlined in the Methods and illustrated in the figures. We used this statistic to determine if poor readers were at higher risk of atypical scores on any of the emotional health measures that showed statistically reliable relationships with reading or spelling identified in the third step in the analysis. A typical population refers to performance that falls within the expected range while an atypical population refers to performance that falls outside the expected range (i.e., reading ability below one standard deviation). The results are illustrated in Table 7.

These results indicated that approximately 17% of our poor readers showed high perceived reading difficulty (compared to 16% in a typical population), 57% showed low perceived reading competence (compared to 16% in a typical population), 67% showed

low reading attitudes (compared to 16% in a typical population), and 53% showed low overall reading self concept (compared to 16% in a typical population). As illustrated by Figure 7, 31% of our poor readers and spellers had atypically high/low scores on the anxiety measure (compared to 16% in a typical population). As illustrated by Figure 8, 37% of our poor readers and spellers had typically high/low scores on the depression measure (compared to 6% in a typical population).

Table 7

Proportion of poor readers performing in the atypical range on emotional health measures compared to a typical population

	Poor Readers		Typical Population
	%	N	%
Perceived Reading Difficulty	17	28	16
Perceived Reading Competence	57	28	16
Reading Attitude	67	28	16
Reading Self-Concept Total	53	28	16
Anxiety Total	31	29	16
Depression	37	29	6

Discussion

The aims of this study were to better understand the relationships between different types of poor reading and different types of emotional health. To this end, we tested 29 children with poor reading for different types of reading and spelling problems (i.e., nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of emotional health problems including reading self-concept (perceived reading competence, perceived reading difficulty, reading attitude), anxiety,

and depression. We used Pearson r correlation coefficients to determine if there were any statistically reliable relationships between poor readers' reading, reading self-concept, anxiety, and depression. We then calculated the proportion of poor readers with atypical scores on the emotional health measures to determine if poor readers were at a higher-than normal risk for problems with the types of reading self-concept, anxiety, or depression that were found to be related to poor reading.

The relationship between poor reading or spelling and reading self-concept

The Pearson r correlation coefficients revealed statistically reliable relationships between each of the reading self-concept scales and different types of reading. Specifically, there were moderate-to-strong correlations between perceived reading difficulty and nonword reading (-.41), irregular reading (-.49), reading comprehension (.51), and irregular spelling (-.45); perceived reading competence and nonword spelling (r = .41); and reading attitude and nonword spelling (r = .47). In addition, poor readers had a much high incidence of atypical scores for perceived reading competence (53%) and reading attitude (67%) compared to a typical population (16%). Considered together, these outcomes suggest that various reading abilities are related to perceived reading difficulty, perceived reading competence, and reading attitude, and that poor reading puts children at higher risk for experiencing poor perceived reading competence and poor reading attitudes. In addition, poor perceived reading competence and poor reading attitude appear to be most reliably associated with poor nonword spelling rather than any other type of poor reading or spelling.

There are at least three reasons why poorer performance on various reading and spelling measures might be associated with poorer scores on various reading self-concept scales. First, poor reading or spelling may have a causal effect on reading self-concept via negative reading and spelling experiences and social comparison with their competent peers (Calsyn & Kenny, 1994; Chapman, Tunmer, & Prochnow, 2000; Moller &

Pohlmann, 2010; Moller et al., 2009). For example, poor readers may make a number of errors when they are asked to read a passage of text aloud to the class. These errors may include omissions, substitutions, changes to the sentence structure, word insertions, poor fluency, or hesitant reading and stumbling over words (i.e., horse for house; Thomson, 1995). Making any of these errors consistently in class would constitute a negative reading experience, which would provide children with direct evidence of their poor reading in comparison to their peers, and hence impair their reading self-concept. This hypothesis is supported by studies that found early reading experiences predict poor reading self-concept (Chapman & Tunmer, 1997; Chapman et al., 2000), poor achieving children engage in upward social comparisons with their high achieving peers (Moller & Pohlmann, 2010; Moller, Pohlmann, Koller, & Marsh, 2009), and that perceptions of your own and others abilities has a direct influence on reading achievement (Fleming et al., 2002). In other words, poor readers awareness of their reading difficulty compared to their competent peers may result in poorer attitudes and more negative thoughts about their reading competence.

Second, poor reading self-concept may have a negative causal effect on reading via poor motivation and reduced exposure to reading (Marsh & Yeung, 1997). For example, a poor reader with poor reading self-concept may try to avoid situations that reveal their difficulties with reading or spelling. This will reduce their reading or spelling practice, and hence impair their reading and spelling development even further relative to their peers. This hypothesis is supported by research reporting poor readers with negative attitudes lack persistent effort, show poor motivation, and avoid practicing tasks compared to those with positive reading attitudes who experience positive academic outcomes (Briggs, 1987; Guo, Connor, Tompkins, & Morrison, 2011; Tymms, 2001; Wasson, Beare, & Wasson, 1990). It is also indirectly supported by studies that have found that (1) children facing broad academic challenges, such children with learning disabilities, are less likely to

practice academic skills (Lackaye & Margalit, 2006); (2) children with poor reading are less likely to be intrinsically motivated to practice reading (Becker, McElvany, & Kortenbruck, 2010); and (3) children's attitudes about reading become more negative as they receive less encouragement about learning to read (Chapman & Tunmer, 1995). In other words, children who are less motivated to read and do not intrinsically enjoy reading are less likely to practice reading and thus, less likely to improve their reading ability.

A third, "reciprocal", explanation for why poor reading was associated with poor reading self-concept is that poor reading may have a causal effect on reading self-concept via negative reading experiences (see above for examples and supporting research), and the resulting poor reading self-concept has a causal effect of learning to read via avoidance of reading and spelling experience (again, see above for examples and supporting research). This theory is directly supported by recent research that found reading achievement predicts reading self-concept, and also evidence that reading self-concept predicts reading achievement (Retelsdorf et al., 2014). Thus poor reading and poor reading self-concept may both cause and effect each other. This is also indirectly supported by empirical studies that have found a reciprocal relationship between academic self-concept and other achievement domains (Marsh & Martin, 2011). In other words, children who do not enjoy reading for pleasure may have less exposure to reading, resulting in less reading practice, which perpetuates their belief that they are poorer readers compared to their peers.

It was interesting to observe that perceived reading competence and reading attitude appeared to be most reliably associated with nonword spelling rather than any other reading or spelling tests. Nonword spelling is a particularly difficult task that involves phonological recoding. Children with poor nonword spelling may make peculiar and unrecognisable spelling errors (i.e., kss for snake) or spelling omissions (i.e., sile for smile) and these bizarre spelling errors can lead children’s written school work to be undervalued (Thomson, 1995). As a consequence, this may cause poor spellers to feel

embarrassed about their spelling performance and lead children to develop beliefs that they are poor spellers (i.e., poor perceived competence) and hold negative feelings towards future spelling tasks (i.e., poor attitudes). In other words, children making unrecognisable or embarrassing spelling errors may feel as though they are less competent compared to their peers. They may also hold negative attitudes towards spelling.

It was also interesting to note that there was no significant association between nonword spelling and perceived reading difficulty. To explain this association, it is possible that poor nonword spellers have developed the concept of "ability". This may mean that children with poor nonword spelling perceive their spelling ability as poorer compared to their peers. This belief that their nonword spelling is poor may lead to perceptions of poor competence rather than perceptions of high difficulty.

In addition, while poor readers may hold negative feelings towards nonword and irregular spelling, the relationship between competence and attitude and poor nonword spelling may be specific because of the importance of phonics during the early stage of learning to read and spell. Children with poor nonword spelling may be more aware of their spelling difficulties, compared to say, sight word spelling of which many children may still be attempting to grasp.

In sum, the outcomes of this study support an association between poor reading and poor reading self-concept, and suggest particular problems with poor perceived reading competence and poor reading attitudes rather than perceived reading difficulty. This concurs with previous research that has found that poor readers have poor reading selfconcept overall (Chapman & Tunmer, 1995, 1997, 2000; Conlon, Zimmer-Gembeck, Creed, & Tucker, 2006; Smith, Smith, Gilmore, & Jameson, 2012). This evidence also suggests how we might address the needs of poor readers in future interventions. Specifically, as well as training poor readers for their reading – or spelling - we may need to improve their perceived reading competence and reading attitude to boost their

motivation to practice reading and spelling. This should improve not only their literacy abilities but also their reading self-concept, which in turn would further increase their motivation to practice. This "virtuous cycle of success" should ultimately improve both the reading and emotional health outcomes for this subgroup of poor readers.

The relationship between poor reading or spelling and anxiety and depression

We also used Pearson r correlation coefficients to measure the reliability and strength of the relationships between different types of reading and different types of emotional health in poor readers. These revealed moderate statistically reliable relationships between reading comprehension and anxiety ($r = -.37$) as well as depression ($r = -.44$). The statistics also revealed a higher incidence of atypical scores for anxiety (31%) and depression (37%) than expected for a typical population (16% and 6%, respectively).

Considered together, this pattern of findings suggests that reading comprehension is related to anxiety and depression, and that poor readers are at higher risk for experiencing anxiety and depression. These results are consistent with previous studies that have found evidence for either anxiety (Arnold et al., 2005; Bonifacci et al., 2014; Carroll & Illes, 2006; Goldston et al., 2007; Grills-Taquechel et al., 2012, 2013; Nelson et al., 2013) or depression in poor readers (Daniel et al., 2006; Mammarella et al., 2014; Morgan et al., 2013). This is also supported by studies that found poor readers are at greater risk of anxiety than typical readers (Carroll et al., 2005), as well as indirectly by studies that have shown worry negatively predicts academic performance (Elliot & McGregor, 1999). However, it is noteworthy that our results do not support previous studies that have not found depression or anxiety in poor readers (Boetsch et al., 1996; Nelson & Gregg, 2012; Undheim, 2003).

Why might there be relationships between anxiety and depression and poor reading comprehension rather than, say, poor word reading or spelling accuracy? This might be

explained by the nature of reading comprehension tests, which tax multiple reading abilities at the same time (i.e., word and nonword reading accuracy and fluency plus spoken comprehension). This may make reading comprehension tests more sensitive to multiple deficits in reading, which in isolation, may relate weakly to anxiety or depression. A second possibility is that anxiety or depression may have a greater impact on reading comprehension than reading accuracy or fluency or spelling abilities. For instance, understanding and tracking the meaning of words presented in sentences or paragraphs requires more concentration than simply reading or spelling individual words. Thus, anxiety and depression, which are associated with poor concentration (American Psychiatric Association, 2013), may have a greater impact on reading comprehension, and hence have a closer relationship with reading comprehension than reading or spelling individual words.

At a general level, why might an association exist between poor reading and anxiety or depression? Regarding anxiety, it is possible that poor reading causes anxiety. Poor readers frequently encounter set backs when reading and struggle to complete reading tasks in class. When poor readers realize that their reading is poorer than their classmates, poor readers may begin to experience frustration, withdrawal and social isolation. These symptoms of poor emotional health, in addition to upward social comparisons, may place poor readers at higher risk of developing anxiety (Bryan et al., 1993; Fleming et al., 2002).

Alternatively, anxiety might cause poor reading because children have difficulty concentrating on reading tasks because of excessive worry (Ialongo et al., 1994; Elliot & McGregor, 1999; Kovacs & Goldston, 1991; Normandeau & Guay, 1998). For example, poor readers with anxiety may try to avoid reading tasks and be less motivated to practice reading. This is supported by research that found children with anxiety were seven times more likely to perform poorly on reading tests compared to children without anxiety

(Ialongo et al., 1994). There is also indirect support for this hypothesis within the related field of test anxiety, which has shown children with high test anxiety have poorer academic performance that children without test anxiety (Weems et al., 2009). Finally, it is also possible that anxiety and poor reading have a reciprocal relationship (Grills-Taquechel et al., 2012). Thus, poor readers with anxiety may experience stress and frustration about their reading ability compared to their peers, which reduces their motivation and likelihood of practicing reading, and thus, maintains their anxiety and further impedes reading improvement.

Regarding depression, there are at least three possible explanations for an association between depression and poor reading. First, poor reading may cause depression. This is supported by one treatment study that found reading training reduced depression in poor readers who showed improvement but not in those who did not improve their reading ability (Kellam et al., 1994). Indirect evidence for this hypothesis also comes from studies that have found that children with learning disabilities and low achievement show depression compared to controls (e.g., Lehtinen, Raikkonen, Heinonen, Raitakari, & Keltikangas-Jarvinn, 2006; Pelkonen, Marttunen, & Aro, 2003). Alternatively, depression may cause poor reading. This is supported by studies that have found that depression has a negative impact on academic achievement (Hishinuma et al., 2012; Juvonen, Nishina, & Graham, 2000). For instance, it is possible that children with depression withdraw from academic tasks, or have higher absenteeism, that reduces reading practice and academic engagement. It is also possible that a third variable moderate the relationship between poor reading and depression (Hishinuma et al., 2012), or that a "reciprocal" relationship exists between poor reading and depression. This theoretical approach would suggest that depression and poor reading each perpetuate the other, leading to ongoing depression and poor reading. However, unfortunately no study to our knowledge has investigated the validity of either of these hypotheses. Considered

together, the evidence provided by this study suggests that poor readers may experience both anxiety and depression. It also supports the possibility that poor emotional health outcomes may relate to some types of reading or spelling problems (e.g., reading comprehension) more than others (e.g., word reading accuracy or fluency).

Limitations and suggestions for future research

Although this study provides some interesting insights into the relationship between poor reading and emotional health, it is not without its limitations. The key limitation is the sample size. Our current sample comprised 29 children with poor reading or spelling. This moderate sample size limits the study's power of detecting reliable relationships between poor reading, reading self-concept, and emotional health. To address this limitation, this study will be replicated to include a larger sample size to increase statistical power (N=60). This will increase our ability to detect reliable relationships between poor reading and poor emotional health in children.

Another limitation of the current study is the self-selection bias of participants who volunteered to participate in this study. Participants were children whose parents volunteered them to complete a reading and emotional health assessment at a university for research purposes. Such children may differ from poor readers whose parents do not seek such assessments. Thus, future research is needed to recruit a larger and more representative sample of children with poor reading, possibly by recruiting children through schools to increase the diversity of children and parents that this study reaches.

Yet another limitation of this study was the use of self-report questionnaires to measure children's emotion health. While children can accurately self-report their emotional health symptoms, often more accurately than their parents (Norwood, 2007; Silverman & Eisen, 1992), future research may consider collecting informant reports from teachers and parents, as well as children. In addition, this study did not measure clinical

levels of anxiety disorders or depressive disorders in poor readers using diagnostic interviews. Rather, we relied on self-report questionnaires and clinical cut-off points that indicate if a child is at risk of an emotional health problem. Future research could include a diagnostic interview to determine if poor readers meet criteria for clinical levels of anxiety and depression.

Finally, the current study only reports correlational data relating to the associations that exist between poor reading and poor emotional health. Correlational data can inform us about association but not direction of causation. While this enabled us to explore the relationship between poor reading and poor emotional health, we were unable to control for the relationships between variables. We aim to address this limitation in future research that recruits a larger sample in order to more closely examine the variables (i.e., reading self-concept, type of reading difficulty, age, sex) that may moderate the relationship between poor reading and anxiety and poor reading and depression. Furthermore, once correlational studies have pinpointed the statistically reliable relationships that exist between different types of reading and different types of reading self-concept, anxiety and depression, it will be useful to use randomized control trials to examine the causal effect of reading training on emotional health, and the causal effect of emotional health intervention on reading ability.

Summary

In sum, this is the first study to examine the relationship between different types of poor reading and reading self-concept, anxiety, and depression. Considered together, the results suggest that different types of poor reading are related to different types of reading self-concept, and that poor readers and spellers are at greater risk for poor perceived reading competence and poor reading attitudes. Similarly, we found that reading comprehension is related to levels of anxiety and depression, and that poor readers are at higher risk for experiencing anxiety and depression. Thus, at a general level, the current

study supports the existence of associations between poor reading and poor reading self-concept, anxiety, and depression; and at a more specific level, suggests that some types of poor reading are more reliably associated with certain types emotional health problems than others.

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Chapter 4

General Discussion

General Discussion

Introduction

The emotional health of poor readers is a relatively new area of enquiry within the field of reading research. Despite rigorous effort, our understanding of the emotional health outcomes for poor readers remains unclear, and the theoretical underpinnings of this association are not well understood. Against this background, the general aim of the present research was to improve our understanding of the relationship between poor reading and poor emotional health. In order to do this, two studies were conducted. In the first, we sought to identify and evaluate the research findings related to the association between poor reading and anxiety and poor reading and depression. In the second study, we sought to understand the relationships between different types of poor reading (i.e., nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of poor emotional health (poor reading self-concept, anxiety, depression). Below, the methods and outcomes of each study are summarized and the theoretical and practical implications of the findings are discussed. Finally, the potential limitations of these studies are considered, and suggestions are offered for how this field of research might move forward.

Summary of Studies

Study 1. The relationship between poor reading and anxiety and depression: A systematic review

To our knowledge, Study 1 is the first systematic review to examine the association between poor reading and different types of anxiety and depression. In this study, we conducted a systematic review adhering to strict exclusion criteria that included studies with children, adolescents, or adults whose (1) reading accuracy, reading fluency, or reading comprehension was at least one standard deviation, one year, or one grade below the expected level, (2) completed the

study in their primary language, (3) completed standardized tests of reading accuracy, reading fluency, or reading comprehension, and (4) completed quantitative tests of anxiety or depression with normative data.

In total, 17 studies met our strict inclusion criteria. Reassuringly, the majority of these studies found an association between poor reading and anxiety, and more specifically, an association between poor reading and separation anxiety, generalized anxiety, and trait anxiety. However, the evidence for an association between poor reading and depression was equivocal. There are three possible explanations for the association between poor reading and anxiety. For instance, it may be that poor reading causes anxiety (Carroll, Maughan, Goodman, & Meltzer, 2005), anxiety causes poor reading (Normandeau & Guay, 1998), or that there is a reciprocal relationship between poor reading and anxiety whereby both factors mutually influence and exacerbate the other (Grills-Taquechel, Fletcher, Vaughn, & Stuebing, 2012). While the reciprocal effects model is the most likely explanation for this relationship, there is limited empirical evidence examining this relationship. Indeed, evidence for each of these theoretical explanations is lacking.

When attempting to characterize the group of poor readers who experienced anxiety, we came across many limitations in the methodologies of the studies included. Firstly, 9 out of 17 studies failed to report information on the type of school attended by participants, 13 out of 17 studies failed to report grade of school, and 5 out of 17 studies failed to report sex of participants. The outcomes of the studies that did report this information suggested that sex may moderate a potential relationship between poor reading and anxiety, with males more likely to experience anxiety than females. There was insufficient evidence to determine the characteristics of poor readers with the remaining variables.

In sum, the key findings of Study 1 was a reliable association between poor reading and anxiety, and more specific associations between poor reading and separation, generalized, and trait anxiety subtypes. The evidence also suggested, albeit tentatively, that male poor readers may be more likely to experience anxiety than female poor readers. While this helps to clarify what we currently know about anxiety for poor readers, we still do not know if a relationship between poor reading and depression exists, since the existing evidence appears to be equivocal.

Study 2. The relationship between poor reading and poor emotional health

In Study 2 we aimed to examine the relationships between different types of poor reading (e.g., nonword reading, irregular reading, reading comprehension, nonword spelling, irregular spelling) and different types of emotional health, including reading self-concept (perceived reading competence, perceived reading difficulty, reading attitude), anxiety and depression. This study was the first to examine the relationships between different types of poor reading and different types of poor emotional health. We recruited 29 children and assessed their reading ability and emotional health. We then examined the associations between these reading and emotional variables.

The results revealed that different types of poor reading were associated with different types of reading self-concept. We found reliable relationships between perceived reading difficulty and nonword reading, irregular word reading, reading comprehension, and irregular spelling. We also found that perceived reading competence and reading attitude were both associated with nonword spelling. We suggested three possible reasons for these relationships: poor reading may have a causal effect on reading self-concept (Chapman & Tunmer, 1997), poor reading self-concept may have a negative causal effect on reading (Briggs, 1987), or poor reading and poor reading self-concept both cause and effect each other (Retelsdorf, Koller, & Moller 2014).

The results also revealed that poor readers showed a higher incidence of atypical scores for anxiety and depression than expected for a typical population, and that within the poor reading sample, poor reading comprehension was associated with anxiety and depression. We suggested that the higher incidence of anxiety and depression in poor readers may be because (1) poor reading causes anxiety and depression (Kellam et al., 1998), (2) anxiety and depression cause poor reading (Normandeau & Guay, 1998), or (3) there is a reciprocal relationship between poor reading and anxiety and depression (Grills-Taquechel et al., 2012).

Considered together, the key findings of Study 2 suggest that different types of poor reading are related to different types of poor reading self-concept, and that poor reading puts children at higher risk for experiencing poor perceived reading competence and poor reading attitudes. These findings support hypotheses that poor readers may be at higher risk for anxiety and depression, and add weight to the idea that poor emotional health outcomes may relate to some types of reading problems more than others.

Limitations and Directions for Future Research

Despite our best efforts, the two studies in this dissertation had at least five limitations. To ensure our systematic review in Study 1 was relatively rigorous, we adhered to strict criteria when selecting studies for inclusion. One criterion was that each study had to control for attention either statistically or via exclusion of poor readers with poor attention. We included this criterion to increase the probability that the outcomes of the included studies reflected a direct association between poor reading and emotional health, rather than an association moderated by poor attention. Unfortunately, this important criterion excluded a number of studies from our review. Now we have examined the associations between poor reading and anxiety and depression without the potentially confounded influence of attention, future systematic reviews may find it useful to examine

these associations using studies that did include poor readers with poor attention to determine if this affects the outcomes.

The main limitation of Study 2 was the sample size. Our sample comprised 29 children with poor reading. This moderate sample size provides less statistical power to detect reliable relationships between poor reading and emotional health than a larger study. Given the promising outcomes of Study 2, we aim to replicate Study 2 within the next year using 60 poor readers. In addition, we aim to improve upon Study 2 by collecting emotional health information from parents and teachers as well as children, and also measuring clinical levels of emotional health using a diagnostic interview.

A limitation of both Study 1 and Study 2 is that they are both based on correlational data. Such data can inform us about associations between variables but cannot inform us about the direction of causation from one variable to another. At this relatively early stage of research, it seems appropriate to use correlational data to pinpoint reliable associations between different types of reading and spelling impairments and different types of poor emotional health. In the future, randomised control trials should be used to test the causal effects that underpin any reliable associations found between poor reading and poor emotional health.

Practical Implications

Despite their limitations, the two studies that comprise this dissertation have produced a number of statistically reliable results, and these findings have important implications for the treatment of poor readers. Most notably, our findings suggest a reliable association between poor reading and anxiety, which suggests that some poor readers may need to be treated for anxiety as well as their reading problems. Treatment studies are now needed to reveal how best to implement anxiety and reading interventions in terms of the order, duration and frequency of treatment.

Our findings also suggest that poor readers experience poor reading competence and poor reading attitudes, and that reading comprehension is associated with anxiety and depression. This suggests that the relationship between poor reading and poor emotional health may be more specific than originally thought. This has implications for identifying the emotional profile of poor readers, as well as the development of targeted interventions for the specific problems faced by poor readers with poor emotional health. For instance, poor comprehenders may benefit from early reading intervention to reduce the likelihood of developing anxiety or depression, or children with anxiety or depression may benefit from emotional health intervention to reduce the likelihood of future reading problems, or a combination of these treatments may be useful. Essentially, elucidating the emotional profile of poor readers will inform us about how to detect and treat the specific problems faced by this subgroup of poor readers.

Summary

In sum, this dissertation set out to better understand the relationship between poor reading and emotional health. To this end, we conducted (1) a systematic review of the relationship between poor reading and anxiety and depression, and (2) an examination of the association between different types of poor reading and different types of emotional health. Considered en masse, the results of these studies support the general idea that poor reading is associated with poor emotional health, and the more specific idea that some types of poor reading are reliably associated with some types of poor emotional health but not others. This research adds to a relatively small field of existing correlational studies that are paving the way towards training trials that will elucidate the causal effects that lie behind any reliable associations we find between poor reading and poor emotional health.

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Appendix

Chapter 2

Appendix A

A1. Customised data extraction form

Title:								
Authors:								
Date, journal, volume, pages:								
Reviewer:								
Full review done? YES NO								
Study Design:								
If No:	ADHD	Primary Language	No Measure of Reading Ability	Did not measure anxiety and/or depression	Medical/Neurological Problems	Qualitative Assessment Only	No Control Data	Other:

Participants					
		Yes	No	NR	
All	Native Speakers				If no, then stop.
	IQ:				
	Within average range				
	Below average range				
	Mixed				
	Exclusion Criteria:				
	ADHD				If yes, then stop.
	Medical problems re: cognition				If yes, then stop.
	Country				
	SES				
	Ethnicity				

Participants						
Poor-Readers	Group Size					
	Sex	F:		M:		
	Age	M:		SD:		Range
	'Dyslexia' Definition					
	Reading Below:	YES	NO	NR	Tests	
	1 SD					
	1 year					
	1 grade					
	Other					
	Type of Dyslexia:	Tests				
	Mixed					
	Phonological					
	Surface					
	Unknown					
	Spoken Language	Tests				
	Unimpaired					
	Impaired					
	Mixed					
	Unknown					

		Yes	No	NR	
Spelling					Tests
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				
Comprehension					Tests
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				
Accuracy					Tests
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				

	Fluency	Tests				
	Unimpaired					
	Impaired					
	Mixed					
	Unknown					

Participants					
Controls	Group Size				
	Sex	F: M:			
	Age	M: SD: Range:			
	Reading Ability	YES	NO	NR	Tests
	1 SD				
	1 year				
	1 grade				
	Other				
	Spoken Language				Tests
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				
	Spoken Language				Tests
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				

Participants					
		Yes	No	NR	Tests
	Spelling				
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				
	Comprehension	Tests			
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				
	Accuracy	Tests			
	Unimpaired				
	Impaired				
	Mixed				
	Unknown				

Fluency	Tests					
Unimpaired						
Impaired						
Mixed						
Unknown						

Methodology					
Type	Interview/Qualitative Only				If yes, stop here.
	Interview/Qualitative Ax				
	Child Qs				Tests:
	Parent Qs				Tests:
	Teacher Qs				Tests:
	Mode				
	Place				
	Tests Administered				

Primary Outcomes								
	Subscale	Poor Readers			Controls/Typical Readers			t, F, p, ES
		M	SD	N	M	SD	N	
Accuracy								
Fluency								
Comprehension								
Spelling								
Anxiety								
Depression								

Additional References/Comments/Concerns	

Appendix B

B1. Summary of evidence for and against poor reading and anxiety

Anxiety					
		Studies finding evidence for an association between reading and anxiety (N = 11)		Studies finding no evidence for anxiety (N = 3)	
		Impaired	Not impaired	Impaired	Not impaired
Anxiety types	Total	1A 2A 3A 11A			12A 13A 14A
	Social	5A 9A 3A	2A 7A 8A 10A 5A		
	Separation	2A 7A 8A	9A		
	State	5A	4A 5A		
	Trait	4A 6A	5A		
	Generalised/worry	3A 8A 9A 11A 10A	10A		
	Specific phobia	3A	1A 3A 8A		
	Academic/test	5A 10A			
	Physical/somatic		2A 7A 10A		
	Harm avoidance	2A 7A			
	Obsessive-compulsive		1A		
	Panic		8A		
	School		9A		
Poor reading types	Word reading accuracy	3A 5A 7A 8A 9A 10A 11A 4A		14A 12A	
	Letter-word ID	2A 3A 6A 10A		13A	
	Phonological recoding	2A 6A 10A		13A 12A	
	Reading fluency	2A 4A 9A 10A 5A 7A		13A	
	Reading Comprehension	7A 10A 11A 6A	9A	14A	
	Spelling	8A 11a		13A 14A	
Age (years)	Mean	16.61		25.26	
	Range	5-44		10-45	
	Median	15		19	
Sex	Equal ratio (10 or less diff)	3A 6A 9A 10A		13A	
	More females	5A			
	More males	1A 2A 8A 11A			
	NR	4A 7A		12A 14A	
IQ	Average	4A 9A 10A		12A 13A 14A	
	Not reported	1A 2A 3A 5A 6A 7A 8A 11A			
Attention control	Via exclusion				
	Via statistics	3A 6A 7A 8A 11A		13A	
	Not controlled	1A 2A 4A 5A 9A 10A		12A 14A	
Language/country	English/US	2A 3A 6A 7A 10A 11A		12A 13A 14A	
	English/UK	5A 8A			
	Norwegian/Norway	1A			
	Italian/Italy	4A 9A			
School	Mainstream school or college	3A 6A 7A 9A 10A		13A	
	Not reported	1A 2A 4A 5A 8A 11A		12A 14A	

Note. The values (e.g., 1A) correspond the relevant anxiety study in Table 1 (systematic review).

Appendix C

C1. Summary of evidence for and against poor reading and depression

Depression					
		Studies finding evidence for		Studies finding no evidence for	
		Impaired	Not impaired	Impaired	Not impaired
Depression types	Total Depression	1D 2D 3D	3D 9D	6D	7D 8D 10D 11D
	Major Depressive Disorder	4D			
	Sad and lonely	5D			
	Unpopular	5D			
	Global self worth				7D
	Mood				7D
	Energy				7D
	Suicide ideation				7D
	Self blame				7D
	General hopelessness				7D
Poor reading types	Word reading accuracy	1D 3D 5D		7D 12D 6D	
	Letter-word ID	4D 9D		10D 11D	
	Phonological recoding	4D 9D		10D 11D	
	Reading fluency	6D		11D 12D	
	Reading Comprehension	1D 5D 9D		7D	6D
	Spelling	1D 3D		7D 11D	
Age (years)	Mean	10.86		26.30	
	Range	5-15.4		10.87 – 45.67	
	Median	10.5		21.20	
Sex	Equal ratio (10 or less diff)	4D 9D		11D 6D	
	More females				
	More males	1D 2D 3D		8D	
	NR	5D		7D 10D 12D	
IQ	Average			7D 10D 11D 12D 6D	
	Not reported	1D 2D 3D 4D 5D 9D		8D	
Attention	Via exclusion				
	Via statistics	1D 2D 3D 9D		11D	
	Not controlled	4D 5D		7D 8D 10D 12D 6D	
Country/language	US/English	1D 2D 4D 5D 9D		7D 10D 11D	
	UK/English	3D			
	Norway/Norwegian			8D	
	Italy/Italian			12D 6D	
School	Mainstream school or college	2D 4D 5D		9D 11D 6D	
	Not reported	1D 3D		7D 8D 10D 12D	

Note. The values (e.g., 1D) correspond the relevant depression study in Table 2 (systematic review).

Chapter 3

Appendix D

D1. Reading Ability and Emotional Health Questionnaire

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4126
deanna.francis@students.mq.edu.au
ABN 90 952 801 237
CRICOS Provider No 00002J

The Relationship between Emotional Health and Children's Reading Ability

Questionnaire

Date of Birth: ___ / ___ / _____

Sex: (please circle) Male Female

Grade of School: _____

Did your child:

Attend kindergarten/prep and every year after that? YES/NO
Skip a year? YES/NO
If so, what year(s) did they skip? _____
Repeat a year? YES/NO
If so, what year(s) did they repeat? _____

Section 1: Spoken Language

Did your child speak his/her first word at around 1-year? YES/NO

Did s/he start to combine words at about the age of 2 1⁄2? (e.g., want truck, dad arm) YES/NO

Is your child English-speaking only? YES/NO

If yes, please proceed to ***Section 2.***

What languages do you speak at home?

_____

_____

Is your child fluent in these languages? YES/NO

How long has your child lived in an English-speaking country?

_____

_____

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4126
deanna.francis@students.mq.edu.au
ABN 90 952 801 237
CRICOS Provider No 00002J

How long have they spoken English?

_____

_____

Does your child speak English as well as schoolmates? YES/NO

Section 2: Familial history

Are there any siblings or other family members with reading or spelling difficulties? YES/NO

If yes, please specify:

_____

_____

Are there any siblings or other family members with anxiety, depression, or other psychological condition?

YES/NO

If yes, please specify:

_____

_____

Section 3: Developmental & Medical History

Did your child reach physical developmental milestones in time? YES/NO

(e.g., crawling/walking)

_____

_____

Does your child have normal hearing? YES/NO

Does your child have normal vision YES/NO

(or corrected to normal with glasses/contact lenses)?

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4126
deanna.francis@students.mq.edu.au
ABN 90 952 801 237
CRICOS Provider No 00002J

MACQUARIE University

Does your child have a history of:

- Head injury? YES/NO
- Seizures? YES/NO
- Epilepsy? YES/NO
- Other neurological condition? YES/NO

Has your child been diagnosed with:

- ADHD or ADD YES/NO
- Autism or Asperger's Syndrome YES/NO
- Specific Language Impairment YES/NO
- Dyspraxia YES/NO
- Central auditory processing disorder YES/NO
- Developmental delay YES/NO

If YES to any of the above, please specify (e.g., age of diagnosis/treatment):

_____

_____

Section 4: Emotional Health

Has your child received a diagnosis of anxiety and/or depression? YES/NO

If yes, please specify (e.g., what was the diagnosis? when was the diagnosis?):

_____

_____

Has your child received any other psychological or psychiatric diagnoses? YES/NO

If yes, please specify (e.g., what was the diagnosis? when was the diagnosis?)

_____

_____

Does your child currently see (or has in the past) a psychologist/psychiatrist? YES/NO

_____

_____

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Ethics Approvals

Appendix E

Appendix E

E1. Ethics approval.

Office of the Deputy Vice-Chancellor
(Research)

Research Office
Research Hub, Building C5C East
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4459
http://www.research.mq.edu.au/
ABN 90 952 801 237

MACQUARIE University
SYDNEY·AUSTRALIA

11 June 2015

Associate Professor Genevieve McArthur
Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109

Dear Associate Professor McArthur

Reference No: 5201500286

Title: *The relationship between emotional health and children's reading ability*

Thank you for submitting the above application for ethical and scientific review. Your application was considered by the Macquarie University Human Research Ethics Committee (HREC (Human Sciences & Humanities)) at its meeting on 24 April 2015 at which further information was requested to be reviewed by the Ethics Secretariat.

The requested information was received with correspondence on 1 June 2015.

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted at:

- Macquarie University

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007 – Updated March 2014) (the *National Statement*).

This letter constitutes ethical and scientific approval only.

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement,* which is available at the following website:

http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All adverse events, including events which might affect the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

The HREC (Human Sciences and Humanities) Terms of Reference and Standard Operating Procedures are available from the Research Office website at:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics

The HREC (Human Sciences and Humanities) wishes you every success in your research.

Yours sincerely

Dr Karolyn White
Director, Research Ethics & Integrity,
Chair, Human Research Ethics Committee (Human Sciences and Humanities)

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007) and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

cc. Ms Deanna Francis

Details of this approval are as follows:

Approval Date: 10 June 2015

The following documentation has been reviewed and approved by the HREC (Human Sciences & Humanities):

Documents reviewed	Version no.	Date
Macquarie University Ethics Application Form	2.3	July 2013
Correspondence from Ms Deanna Francis responding to the issues raised by the HREC (Human Sciences and Humanities)		Received 1/06/2015
Signed Consent for Recruiting Participants		17/3/2015
MQ Participant Information and Consent Form (PICF) (Parent/Guardian)	1	8/05/2015
MQ Participant Information and Consent Form (Child)	1	23/3/2015
Task Descriptors		
Participant Questionnaires & Scales: • Spence Children's Anxiety Scale • Mood and Feelings Questionnaire (Short Version) • Children's Automatic Thoughts Scale (CATS) • Strengths and Difficulties Questionnaire • Reading Self-Concept Scale – Original Version • The Relationship between Emotional Health and Children's Reading Ability Questionnaire		