

The Relationship Between Children's Reading Ability and Emotional Health

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This thesis is presented for the Degree of

Doctor of Philosophy

14th June, 2019

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THESIS SUMMARY

Around 16% of children have reading skills that fall below the average range for their age, and 5% of children have significant reading difficulties. It is well understood that poor reading increases a child's risk of school failure. However, we are only just beginning to understand how poor reading may affect a child's emotional health.

The overarching goal of this thesis was to improve our understanding of the association between poor reading and emotional health. To this end, this thesis addressed five specific aims. The first was to determine if there is a reliable association between poor reading and anxiety. We conducted a systematic review and meta-analysis investigating associations between poor reading and internalising problems, anxiety, and depression. We found a statistically reliable and moderate association between poor reading and internalising problems, which appeared to be driven by anxiety.

Our second aim was to determine whether certain types of poor reading are associated with certain types of anxiety. We conducted a profiling study with groups of children with different reading and anxiety profiles, and compared the groups on different types of poor reading and anxiety. We found that poor readers with anxiety were characterised by multiple word reading problems as well as social anxiety.

The third aim of this thesis was to start to formulate a comprehensive evidence-based hypothesis about the mechanisms that may link poor reading and anxiety. In a profiling study, we investigated four potential mechanisms: poor reading self-concept, poor peer relations, poor attention, and poor behaviour. We discovered that poor reading self-concept and poor attention were particularly prevalent in poor readers with anxiety, suggesting that these variables may act as mechanisms linking poor reading and anxiety.

Our fourth aim was to develop an integrated treatment for children with poor reading and anxiety. Hence, we developed "Cool Reading", which combined reading and anxiety

treatment components. We carefully tailored Cool Reading to suit children with reading difficulties, and we conducted a pilot study to explore whether Cool Reading might have an effect on reading and anxiety outcomes. The results were promising, and hence the final aim of this thesis was to evaluate the suitability and efficacy of Cool Reading in a controlled interventional case series study. Overall, we found that Cool Reading significantly improved directly trained reading skills and significantly reduced anxiety. Considered together, the knowledge gained through this dissertation paves the way towards improving the lives of children with concomitant poor reading and anxiety.

STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself. This dissertation presents a “thesis by publication” format. Chapter 2 is presented as a stand-alone manuscript that has been published in Clinical Psychology Review. Information in Chapter 3 and in Chapters 4 to 6 will also be submitted as manuscripts for peer review once they have been revised based on feedback from the thesis examiners. A concerted effort has been made to reduce unnecessary repetition between chapters wherever possible.

Deanna Francis

14th June, 2019

ACKNOWLEDGEMENTS

This PhD experience has been a journey like no other, made possible only by a number of wonderful people who have helped to make this dream a reality. The first person I wish to thank is my supervisor, Genevieve McArthur. Gen, words escape me when I reflect on what an immense journey this has been. I feel so overwhelmingly grateful to have had this opportunity to learn from you. Thank you for sharing your wisdom with me, for challenging me, and for pushing me further than I thought was possible. Thank you for your unwavering encouragement and belief in me. Thank you for supporting me from the very, very beginning. You are inspiration to me like no other, and I feel so very fortunate to have had this experience with you as my mentor. Wholeheartedly - thank you, Gen.

Thank you to my associate supervisor, Jennifer Hudson. Thank you for guiding me through countless clinical challenges, and equipping me with the skills to complete this PhD. Thank you for sharing your knowledge with me and supporting me throughout this journey.

To Saskia Kohnen, thank you for introducing me to the clinical world of reading treatment. Thank you for teaching me, forever challenging me, furthering my knowledge, and supporting me throughout this experience. This achievement would not have been possible without you.

To the Macquarie University Reading Clinic team - Erin, Lesley, Elena, Thushara, Stuart, and Leanne. Thank you for your support. Thank you for your friendship and words of encouragement right to the very the end.

To my colleagues - Nic Badcock, Serje Robidoux, and Nate Caruana. Nic, thank you for enriching my technological capacity, for your feedback on this dissertation, and your motivational words of encouragement. Serje, thank you for sharing your statistical wisdom with me. Nate, thank you for your contribution to this dissertation and your support throughout this experience.

An enormous thank you also goes to the administration staff within the Department, especially to Lesley McKnight. Lesley, thank you for your support and your knowledge of all things PhD. Thank you for checking in and helping me reach submission. I am very grateful for your support, thank you – you are a true gem.

Perhaps the most difficult thank you to write is to those who are closest to me. Thank you to my friends and family who have shared in the triumphs and challenges of this journey. I am extraordinarily lucky to have so many wonderful people who have supported me through the countless daily challenges of this experience. A very special thank you to Samantha. Sam, thank you for always being there and supporting me more times than I can remember. To my incredibly strong Mum, thank you for being my rock, forever offering your unwavering support, and entertaining me with the mischievous tales of Benny Benson. To my Dad, thank you for encouragement and giving me the tenacity to embrace new challenges.

To my wonderful partner, Ryan, thank you for your endless support and belief in me. Thank you for uplifting me through the difficult times and providing me the courage to carry on when I believed it was out of reach. Thank you for embracing and sharing this experience with me, for which I will never forget. With the utmost heartfelt thanks – thank you Ry, for believing in me right to the very end.

CHAPTER 1

General Introduction

GENERAL INTRODUCTION

Reading is an important benchmark in early education, and is critical to academic success. However, 16% of children have reading skills that fall below the average range for their age or grade, and 5% of children have significant difficulties learning to read (Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992). We know that poor reading increases a child's risk for negative academic outcomes (Herbers et al., 2012; Smart, Prior, Sanson, & Oberklaid, 2001; Smart, Youssef, Sanson, Prior, Toumbourou, & Olsson, 2017). However, we are only just beginning to understand how poor reading may impact a child's life beyond academic failure.

Consider the case of Sophie (name changed), a 10-year-old girl progressing through her school years. Sophie's reading ability is well below her peers. She has poor word reading accuracy (i.e., difficulty reading regular words such as "her" and irregular words such as "friend"), poor reading fluency (i.e., slow and laborious reading), and poor reading comprehension (i.e., difficulty understanding the meaning of text). These reading problems make it difficult for Sophie to access the school curriculum. She needs additional support to complete class activities because she cannot read worksheet instructions. She has been placed in the lowest reading group and reads "easier" books than her peers. She is segregated from her classmates when she attends learning support assistance during class time. Sophie refuses to participate in class discussions. She is too embarrassed to ask her teacher for help. Sophie worries about what other children think of her and she worries a lot about getting into trouble. Sophie feels different and she feels isolated and alone. School is extremely challenging for Sophie and she avoids going whenever possible.

Sophie's story is not unique. Over the past two decades, researchers and reading specialists have suggested that repeated failure in the classroom may contribute to a child's anxiety (Carroll, Maughan, Goodman, & Meltzer, 2005; Galuschka & Schulte-Korne, 2016;

Maughan, 1995; Maughan & Carroll, 2006; Riddick, Sterling, Farmer, & Morgan, 1999).

Anxiety is a common childhood problem that affects approximately 10% of children (Copeland, Angold, Shanahan, & Costello, 2014). There are different types of anxiety. Some children worry about negative evaluation or rejection from their peers (i.e., social anxiety). Others report intrusive and pervasive worries about school, their friendships, or things going on in the world (i.e., generalised anxiety). There are children who worry about being apart from their family (i.e., separation anxiety), or experience a specific fear associated with an object or situation (i.e., specific phobias). And there are children who experience repetitive or intrusive thoughts or behaviours (i.e., obsessive-compulsive disorder), or unexpected, sudden, and intense fear (i.e., panic disorder; Diagnostic and Statistical Manual 5th edition (DSM-5), American Psychiatric Association (APA), 2013). Children may have just one of these anxiety problems, but most children – including Sophie – tend to have problems with multiple types of anxiety.

In recent times, research has started to investigate whether poor reading is a risk factor for anxiety. A number of studies have investigated the potential association between poor reading and anxiety. The majority of these studies have measured anxiety via assessments of "internalising" problems, which are composite measures of anxiety and depression. Some of these studies have found that poor readers have elevated internalising problems compared to typical readers (Boetsch, Pennington, & Green, 1996; Pierce, Wechsler-Zimring, Noam, Wolf, & Katzir, 2013; Snowling, Muter, & Carroll, 2007; Willcutt et al., 2013), while others have not (Arnold et al., 2005; Miller, Hynd, & Miller, 2005). The outcomes of these internalising studies are problematic for two reasons. First, the mixed findings obscure whether a relationship exists between poor reading and internalising problems. Second, the use of composite internalising measures masks whether there is a specific association between poor reading and anxiety.

Fortunately, a group of studies have investigated the specific association between poor reading and anxiety. However, the outcomes of these studies are as mixed as the internalising studies. Some studies have found that poor readers have elevated anxiety compared to typical readers (Arnold et al., 2005; Bonifacci, Montuschi, Lami, & Snowling, 2014; Carroll et al., 2005; Carrol & Iles, 2006; Goldston et al., 2007), while others have failed to find such group effects (Martinez & Semrud-Clikeman, 2004; Nelson & Gregg, 2012). Hence, it is unclear if an association exists between poor reading and anxiety. This motivated the first aim of this dissertation, which was to *measure the strength and reliability of the association between poor reading and anxiety*. We therefore conducted the first systematic review and meta-analysis of well-controlled studies that have compared groups of poor readers and groups of typical readers for internalising problems (i.e., combined measures of anxiety and depression), anxiety, and depression. This study is outlined in Chapter 2.

It is possible that the contradictory nature of the aforementioned findings is a product of the heterogeneous nature of both poor reading (McArthur et al., 2013; McArthur, Castles, Kohnen, & Banales, 2016) and anxiety (APA, 2013; Lumpkin, Silverman, Weeks, Markham, & Kurtines, 2002). In terms of poor reading, it may be that the type of reading problem (e.g., word reading accuracy, reading fluency, or reading comprehension) differentiates poor readers with and without anxiety. Alternatively, it may be that poor reading is associated with some types of anxiety (e.g., social anxiety, generalised anxiety) but not others (e.g., specific phobias). Thus, the second aim of this dissertation was to *determine if there is an association between certain types of poor reading and anxiety*. We conducted a “profiling” study to explore if concurrent poor reading and anxiety problems in children are associated with particular types of poor reading and anxiety. In Chapter 3, we compared four groups of children (poor readers with anxiety, poor readers without anxiety, typical readers with

anxiety, normative control children) for different types of reading problems (phonological recoding, visual word recognition, reading fluency, reading comprehension) and anxiety problems (social anxiety, separation anxiety, generalised anxiety, panic/agoraphobia, physical injury fears, obsessive-compulsive symptoms). We also conducted detailed examinations of co-occurring reading and anxiety problems in 11 children who participated in a pilot interventional case series study in Chapter 5 and a controlled interventional case series study in Chapter 6. We use the outcomes of these studies to identify the types of reading and anxiety problems that are particularly prevalent in poor readers with anxiety.

Given the current uncertainty about the strength of the association between poor reading and anxiety, it is perhaps unsurprising that we lack a detailed and evidence-based theoretical account of the mechanisms that may link poor reading and anxiety (Carroll, et al., 2005; Snow, 2013; Snow, Eadie, Connell, Andersen, McCusker, & Munro, 2013). There are at least four causal hypotheses that offer a starting point from which to develop such a theory. One hypothesis is that poor reading causes anxiety via mechanisms such as poor peer relations (Boyes, Leita, Claessen, Badcock, & Nayton, 2016; Verduin & Kendall, 2008) or poor self-concept (Chapman & Tunmer, 1995; Sowislo & Orth, 2013). An alternative causal hypothesis is that anxiety causes poor reading via mechanisms such as poor attention (Bogels & Mansell, 2004) or poor behaviour (Fraire & Ollendick, 2013). A third potential explanation is that poor reading and anxiety are not directly related at all. Instead, both may be caused by a third factor (e.g., poor attention) that creates a "faux" association between poor reading and anxiety (Angold, Costello, & Erkanli, 1999). A fourth causal hypothesis is that there is a bidirectional causal relationship between the two problems. For example, a child's poor reading might lead to failure in the classroom that is readily apparent to the child. This may lead to the development of poor reading self-concept (Chapman, Tunmer, & Prochnow, 2004), which in turn may result in hypersensitivity to negative evaluation from others, which

is social anxiety (Carroll et al., 2005). This heightened focus on potential negative evaluation may result in reduced attention to classroom activities (Bogels & Mansell, 2004; Mogg et al., 1997) and/or poor behaviour (Fraire & Ollendick, 2013). This would reduce learning opportunities, including reading practice, which in turn may trigger poor reading self-concept and hence exasperate existing problems with anxiety or social anxiety.

The third aim of this dissertation was *to start to formulate a causal hypothesis explaining the association between poor reading and anxiety*. In Chapter 3, we investigated four variables that could potentially link poor reading and anxiety (poor reading self-concept, poor peer relations, poor attention, poor behaviour) and compared these variables in four groups of children (poor readers with anxiety, poor readers without anxiety, typical readers with anxiety, normative control children). We also examined these "linking variables" in 11 children who participated in two interventional case series outlined in Chapter 5 and Chapter 6. We used the outcomes of these studies to determine if these variables may be potential mechanistic links in a causal relationship between poor reading and anxiety.

Whilst research studies continue to delineate the mechanisms that are responsible for an association between poor reading and anxiety, it is important that we attend to the significant needs of the children who suffer from concomitant reading and anxiety problems. To the best of our knowledge, there is no integrated treatment of reading and anxiety problems in children. This is concerning because we know that both poor reading and anxiety are associated with academic failure (Herbers et al., 2012), school dropout (Daniel, Walsh, Goldston, Arnold, Reboussin, & Wood, 2006), relationship difficulties (Luciano & Savage, 2007; Settapani & Kendall, 2013), and limited employment opportunities (Essau, Lewinsohn, Olaya, & Seeley, 2014; Smart et al., 2017). Thus, the fourth aim of this dissertation was *to develop the first integrated treatment for children with concomitant poor reading and anxiety*. In Chapter 4, we outline the scientific evidence for the reading and anxiety treatment

components that comprise this new treatment, which we called "Cool Reading", and we describe the evidence-based clinical tools that we selected to deliver those treatment components. We also describe the modifications that we made to these clinical tools to suit the needs and limitations of poor readers with anxiety.

The fifth aim of this dissertation was *to evaluate the suitability and efficacy of Cool Reading for children with poor reading and anxiety*. Our first step was to conduct a pilot interventional case series study to determine if the procedures of Cool Reading needed to be further refined to suit children with reading and anxiety problems. We also used this study to start to explore the potential efficacy of Cool Reading on numerous reading and anxiety outcomes (Chapter 5). The pilot study included four children with poor reading and anxiety, aged between 8 and 12 years, who completed 12 weeks of Cool Reading treatment.

The promising outcomes of the pilot study encouraged us to assess the effect of Cool Reading in a controlled interventional case series study (Chapter 6). This study was the same as the pilot study in Chapter 5 except that it included (1) a larger number of individual cases (seven children with concomitant reading and anxiety difficulties); (2) control data from a double-baseline non-treatment period; (3) a revised version of Cool Reading that comprised social anxiety treatment components that were introduced earlier in the programme; and (4) more detailed reading outcome measures of the reading cognitive system. The positive outcomes of this study were used to formulate clinical recommendations to treat poor reading and anxiety and guide directions for future research.

Summary

To summarise, the overarching goal of this dissertation is to better understand the association between poor reading and anxiety. To achieve this goal, we measured the strength and reliability of the association between poor reading and anxiety (Aim 1; see Chapter 2); we determined if there was an association between certain types of poor reading and anxiety

(Aim 2; see Chapter 3, 5, and 6); and we started to formulate a causal hypothesis explaining the association between poor reading and anxiety (Aim 3; see Chapter 3, 5, and 6). We also developed an integrated treatment for children with concomitant poor reading and anxiety (Aim 4; see Chapter 4); and we evaluated the suitability and efficacy of Cool Reading for children with poor reading and anxiety (Aim 5; see Chapters 5 and 6). We assimilate the outcomes of these studies in a General Discussion (Chapter 7) which summarises the findings, limitations, and theoretical and clinical implications of this research programme.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.
- Angold, A., Costello, E.J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology and Psychiatry*, 40, 57–87. doi: 10.1111/1469-7610.00424
- Arnold, E. M., Goldston, D. B., Walsh, A. K., Reboussin, B. A., Daniel, S. S., Hickman, E., & Wood, F. B. (2005). Severity of emotional and behavioural problems among poor and typical readers. *Journal of Abnormal Child Psychology*, 33, 205-217. doi: 10.1007/s10802-005-1828-9
- Boetsch, E. A., Green, P. A., & Pennington, B. F. (1996). Psychosocial correlates of dyslexia across the lifespan. *Development and Psychopathology*, 8, 539-562. doi: 10.1017/S0954579400007264
- Bogels, S. M., & Mansell, W. (2004). Attention processes in the maintenance and treatment of social phobia: Hypervigilance, avoidance, and self-focused attention. *Clinical Psychology Review*, 827-856. doi: 10.1016/j.cpr.2004.06.005
- Bonifacci, P., Montuschi, M., Lami, L., & Snowling, M. J. (2014). Parents of children with dyslexia: Cognitive, emotional and behavioural profile. *Dyslexia*, 20, 175-190. doi: 10.1002/dys.1469
- Boyes, M. E., Leita, S., Claessen, M., Badcock, N. A., & Nayton, M. (2016). Why are reading difficulties associated with mental health problems? *Dyslexia*, 22, 263-266. doi: 10.1002/dys.1531
- Carroll, J. M., & Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology*, 76, 651-662. doi: 10.1348/000709905X66233

- Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, 46, 524-532. doi: 10.1111/j.1469-7610.2004.00366.x
- Chapman, J. W., & Tunmer, W. E. (1995). Development of young children's reading self-concepts: An examination of emerging subcomponents and their relationship with reading achievement. *Journal of Educational Psychology*, 87, 154-167. doi: 10.1037/0022-0663.87.1.154
- Chapman, J. W., Tunmer, W. E., & Prochnow, J. E. (2004). Repressed resilience? A longitudinal study of reading, self-perceptions and teacher behaviour ratings of poor and average readers in New Zealand. *Journal of the International Academy for Research in Learning Disabilities*, 22, 9-15. Retrieved from www.iarld.com/the-journal-thalamus
- Copeland, W. E., Angold, A., Shanahan, L., & Costello, E. J. (2014). Longitudinal patterns of anxiety from childhood to adulthood: The great smoky mountains study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 53, 21-33. doi: 10.1016/j.jaac.2013.09.017
- Copeland, W. E., Shanahan, L., Costello, E. J., & Angold, A. (2010). Childhood and adolescent psychiatric disorders as predictors of young adult disorders. *Archives of General Psychiatry*, 66, 764-772. doi:10.1001/archgenpsychiatry.2009.85
- Costello, E. J., Angold, A., & Keeler, G. P. (1999). Adolescent outcomes of childhood disorders: the consequences of severity and impairment. *Journal of the American Academy of Child and Adolescent Psychiatry*, 38, 121-128. doi: 10.1097/00004583-199902000-00010

- Daniel, S. S., Walsh, A. K., Goldston, D. B., Arnold, E. M., Reboussin, B. A., & Wood, F. B. (2006). Suicidality, school dropout, and reading problems among adolescents. *Journal of Learning Disabilities, 39*, 507-514. doi: 10.1177/00222194060390060301
- Essau, C. A., Lewinsohn, P. M., Olaya, B., & Seeley, J. R. (2014). Anxiety disorders in adolescents and psychosocial outcomes at age 30. *Journal of Affective Disorders, 163*, 125-132. doi:10.1016/j.jad.2013.12.033
- Fraire, M. G., & Ollendick, T. H. (2013). Anxiety and oppositional defiant disorder: A transdiagnostic conceptualisation. *Clinical Psychology Review, 33*, 229-240. doi: 10.1016/j.cpr.2012.11.004
- Galuschka, K., & Schulte-Körne, G. (2016). Clinical practice guideline: The diagnosis and treatment of reading and/or spelling disorders in children and adolescents. *Deutsches Arzteblatt International, 113*, 279-286. doi: 10.3238/arztebl.2016.0279
- Goldston, D. B. et al. (2007). Reading problems, psychiatric disorders, and functional impairment from mid to late adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*, 25-33. doi: 10.1097/01.chi.0000242241.77302.f4
- Herbers, J.E., Cutuli, J.J., Supkoff, L.M., Heistad, D., Chan, C-K., Hinz, E., & Masten, A.S. (2012). Early reading skills and academic achievement trajectories of students facing poverty, homelessness, and high residential mobility. *Educational Researcher, 41*, 366–374. doi: 10.3102/0013189X12445320
- Luciano, S., & Savage, R. S. (2007). Bullying risk in children with learning difficulties in inclusive educational settings. *Canadian Journal of School Psychology, 22*, 14-31. doi: 10.1177/0829573507301039
- Lumpkin, P. W., Silverman, W. K., Weems, C. F., Markham, M. R., & Kurtines, W. M. (2002). Treating a heterogeneous set of anxiety disorders in youths with group

- cognitive behavioural therapy: A partially nonconcurrent multiple-baseline evaluation. *Behaviour Therapy*, 33, 163-177. doi: 10.1016/S0005-7894(02)80011-9
- Martinez, R. S., & Semrud-Clikeman, M. (2004). Emotional adjustment and school functioning of young adolescents with multiple versus single learning disabilities. *Journal of Learning Disabilities*, 37, 411-420. doi: 10.1177/00222194040370050401
- Maughan, B. (1995). Annotation: Long-term outcomes of developmental reading problems. *Journal of Child Psychology and Psychiatry*, 36, 357-371. doi: 10.1111/j.1469-7610.1995.tb01296.x
- McArthur, G., Castles, A., Kohnen, S., & Banales, E. (2016). Low self-concept in poor readers: Prevalence, heterogeneity, and risk. *PeerJ*, 4e2669. doi: 10.7717/peerj.2669
- McArthur, G., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., Banales, E., & Castles, A. (2013). Getting to grips with the heterogeneity of developmental dyslexia. *Cognitive Neuropsychology*, 30, 1-24. doi: 10.1080/02643294.2013.784192
- Miller, C. J., Hynd, G. W., & Miller, S. R. (2005). Children with dyslexia: Not necessarily at risk for elevated internalising symptoms. *Reading & Writing*, 18, 425-436. doi: 10.1007/s11145-005-4314-4
- Mogg, K., Bradley, B. P., de Bono, J., & Painter, M. (1997). Time course of attentional bias for threat information in non-clinical anxiety. *Behaviour Research and Therapy*, 35, 297-303. doi: 10.1016/S0005-7967(96)00109-X
- Pierce, M. E., Wechsler-Zimring, A., Noam, G., Wolf, M., & Katzir, T. (2013). Behavioural problems and reading difficulties among language minority and monolingual urban elementary school students. *Reading Psychology*, 34, 182-205. doi: 10.1080/02702711.2011.626108
- Riddick, B., Sterling, C., Farmer, M., & Morgan, S. (1999). Self-esteem and anxiety in the educational histories of adult dyslexic students. *Dyslexia*, 5, 227-248. doi:

10.1002/(SICI)1099-0909

Settipani, C. A., & Kendall, P. C. (2013). Social functioning in youth with anxiety disorders:

Association with anxiety severity and outcomes from cognitive-behavioural therapy.

Child Psychiatry and Human Development, 44, 1-18. doi: 10.1007/s10578-012-

0307-0

Shaywitz, S.E., Escobar, M.D., Shaywitz, B.A., Fletcher, J.M., & Makuch, R. (1992).

Evidence that dyslexia may represent the lower tail of a normal distribution of reading ability. *New England Journal of Medicine*, 326, 145–150. doi:

10.1056/NEJM199201163260301

Smart, D., Prior, M., Sanson, A., & Oberklaid, F. (2001). Children with reading difficulties:

A six-year follow-up from early primary school to secondary school. *Australian*

Journal of Psychology, 53, 45–53. doi: 10.1080/00049530108255121

Smart, D., Youssef, G. J., Sanson, A., Prior, M., Toumbourou, J. W., & Olsson, C. A. (2017).

Consequences of childhood reading difficulties and behaviour problems for educational achievement and employment in early adulthood. *British Journal of*

Educational Psychology, 87, 288-308. doi: 10.1111/bjep.12150

Snow, P. (2014). Oral language competence and the transition to school: Socio-economic and

behavioural factors that influence academic and social success. *International Journal*

on School Disaffection, 11, 3-24. doi: 10.18546/IJSD.11.1.01

Snow, P.C., Eadie, P.A., Connell, J., Andersen, B., McCusker, H.J., & Munro, J.K. (2013)

Oral language supports early literacy: A pilot cluster randomized trial in

disadvantaged schools. *International Journal of Speech Language Pathology*, 16,

495-506. doi: 10.3109/17549507.2013.845691

Snowling, M. J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A

follow-up in early adolescence. *Journal of Child Psychology and Psychiatry*, 48, 609-

618. doi: 10.1111/j.1469-7610.2006.01725.x

Sowislo, J. F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*, 139, 213-240. doi: 10.1037/a0028931

Verduin, T. L., & Kendall, P. C. (2008). Peer perceptions and liking of children with anxiety disorders. *Journal of Abnormal Child Psychology*, 36, 450-469. doi: 10.1007/s10802-007-9192-6

Willcutt, E. G., Petrill, S. A., Wu, S., Boada, R., DeFries, J. C., Olson, R. K. et al. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities*, 46, 500-516. doi: 10.1177/0022219413477476

CHAPTER 2

The Association between Poor Reading and Internalising Problems: A Systematic Review and Meta-Analysis

Francis, D. A., Caruana, N., Hudson, J. L., & McArthur, G. M. (2018). The association between poor reading and internalising problems: A systematic review and meta-analysis. *Clinical Psychology Review*, 57, 45-60. doi: 10.1016/j.cpr.2018.09.002

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Author's statement: DF and GM developed the methods of this study, including the study selection and data extraction criteria. DF developed the search strategy in collaboration with GM and JH who provided expertise on poor reading and internalising problems, respectively. DF conducted the search. DF and GM screened the studies identified by the search. DF and NC extracted the data. DF conducted the meta-analysis. DF composed the first draft of the

manuscript and GM, JH, and NC provided comment and feedback and have approved the final manuscript.

ABSTRACT

Numerous studies have demonstrated an association between learning disabilities and internalising problems such as anxiety and depression. However, our understanding of this association for people with specific types of learning disability – such as poor reading – is poorly understood. Here, we present the first systematic review and meta-analysis of studies that have examined associations between poor reading and internalising problems – including anxiety and depression – in children, adolescents, and adults. Our systematic search identified 34 studies comprising 16,275 participants ($N = 2,491$ poor readers). Our meta-analysis revealed statistically significant differences between poor readers and typical readers on general measures of internalising problems ($d = 0.41$), as well as specific measures of anxiety ($d = 0.41$) and depression ($d = 0.23$). These outcomes suggest that poor readers are at moderate risk for experiencing internalising problems compared to typical readers, which appears to stem from a greater risk for anxiety than depression.

Keywords: poor reading; internalising; anxiety; depression.

INTRODUCTION

Internalising problems, anxiety, and depression

Traditionally, “internalising” has been an umbrella term used to refer to inwardly focused emotional problems that contrast with outwardly focused “externalising” behavioural problems (Achenbach, 1966; Achenbach & Edelbrock, 1978). Internalising problems include numerous heterogeneous disorders such as anxiety, depression, trauma, and dissociative disorders. Defining these disorders is complex. The Diagnostic and Statistical Manual (DSM: now in its 5th edition; *DSM-5*; American Psychiatric Association [APA], 2013) defines such disorders based on clusters of symptoms that co-occur within a clinical population, and a diagnosis is based on the number and duration of symptoms that meet certain criteria. The DSM further categorises numerous subtypes of internalising disorders (i.e., generalised anxiety, separation anxiety, major depression), which are defined by constellations of unique and overlapping internalising symptoms (e.g., worry, low mood, withdrawal). In the current review, we focus on two of the most common internalising disorders in modern western society – anxiety and depression (Baxter, Scott, Vos, & Whiteford, 2012; Kessler, Chiu, Demler, & Walters, 2005).

There are numerous subtypes of anxiety such as generalised anxiety, separation anxiety, social anxiety, specific phobias, and panic disorder (APA, 2013), as well as other types of anxiety such as trait anxiety, state anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and test anxiety (Beidel, 1988). These anxiety problems comprise general symptoms of anxiety (e.g., avoidance, worry, physical symptoms) as well as more specific and defining anxiety symptoms (e.g., fear of a specific object). In terms of anxiety disorder subtypes, generalised anxiety is defined by pervasive worry in many areas for more days than not, and is typically accompanied by physical symptoms and distress. Separation anxiety is characterised by worry about separation from parents or caregivers, distress at the time (or

ahead of time) of separation, reassurance seeking, and sleep disturbance. For social anxiety, the symptoms are predominantly fear of negative evaluation in social or performance situations, distress before or during the social situation, and avoidance of situations where negative evaluation is possible. Specific phobias are characterised by intense fear to a specific object or situation that is avoided or endured with severe distress. Panic disorder is defined by rapid and intense fear in the absence of an immediate feared object or situation (APA, 2013). In terms of other types of anxiety, state anxiety is defined as anxiety experienced at any given moment, while trait anxiety is defined as a person's tendency to interpret situations as threatening (Spielberger et al., 1983). Finally, test anxiety is defined as excessive fear or worry surrounding test situations, with particular worry about the consequences of performing poorly on a test (Beidel, 1988). Research also suggests that fear of negative evaluation is a core feature of test anxiety, and this type of anxiety has also been associated with generalised and social anxiety (Beidel & Turner, 1988; Bogels et al., 2010).

There are also numerous subtypes of depression such as major depressive disorder, persistent depression disorder (previously termed "dysthymia), and disruptive mood dysregulation disorder (APA, 2013). Major depressive disorder is defined by feeling very down or sad, lack of interest in previously enjoyed activities, change in appetite and weight, poor sleep, slowed motor movements, lack of energy, and poor concentration for more days than not – with these symptoms occurring over a two-week period. Persistent depression disorder is defined by similar symptoms but the symptoms occur for one year. Disruptive mood dysregulation disorder is defined by anger or temper outbursts that involve aggression towards another person for no good reason, the outbursts occur three or more times per week for at least a full year, and occur in different contexts such as home, school, or public places (APA, 2013).

Recent studies have shown that people with general learning disabilities are at higher risk for these internalising problems compared to the typical population (for a review, see Nelson & Harwood, 2011a; 2011b). However, it is not yet clear whether children with specific learning disabilities – such as poor reading, poor spoken language, poor attention – are at higher risk for certain types of internalising problems (e.g., anxiety, depression) or certain subtypes of such problems (e.g., separation anxiety, major depression disorder). To start clarifying this issue, this systematic review and meta-analysis examines the associations between one specific learning disability – poor reading – and two types of internalising problems – anxiety and depression.

Poor readers

The reading abilities of 16% of children fall below the average range for their age or grade, and 5% of children have significantly impaired reading skills for their age (Shaywitz et al., 1995). These “poor readers” have different kinds of reading problems, such as learning to read new words using the grapheme-phoneme correspondence (GPC) rules (i.e., poor “phonological recoding”) or by recognising whole written words from memory (i.e., poor “visual word recognition”). Poor readers may also struggle to learn to read words fluently (i.e., poor “reading fluency”) or with understanding the meaning of what they read (i.e., poor “reading comprehension”; Stuart & Stainthorp, 2016). While a proportion of poor readers present with just one of these reading problems (e.g., “phonological dyslexia”, “surface dyslexia”, “poor comprehenders”; McArthur et al., 2013; Nation, Cocksey, Taylor, & Bishop, 2010), the majority have a number of these reading problems (Castles & Coltheart, 1993; Goulandris & Snowling, 1991).

Internalising problems in poor readers

As mentioned above, it is unclear if poor reading is associated with an increased risk for internalising problems overall, or certain types or subtypes of internalising problems more

specifically. To date, some studies have found that poor readers have more general internalising problems than typical readers (Boetsch, Green, & Pennington; 1996; Snowling, Muter, & Carroll, 2007), but others studies have not (Arnold et al., 2005; Miller, Hynd, & Miller, 2005). Similarly, some studies have found that poor readers have more problems with anxiety (Arnold et al., 2005; Bonifacci, Montuschi, Lami, & Snowling, 2014; Goldston et al., 2007) and depression than typical readers (Arnold et al., 2005; Daniel, Walsh, Goldston, Arnold, Reboussin, & Wood, 2006; Maughan, Rowe, Loeber, & Stouthamer-Loeber, 2003), while other studies have not (Grills, Fletcher, Vaughn, Barth, Denton, & Stuebing, 2014; Martinez & Semrud-Clikeman, 2004; Nelson & Gregg, 2012). Thus, there appears to be considerable inconsistencies between studies investigating internalising problems for poor readers.

Within the scientific field of reading research, inconsistent findings between studies about the characteristics of poor readers is typically a red flag for heterogeneity. More specifically, these mixed results suggest that only a proportion or “subgroup” of poor readers may have internalising problems. Thus, we propose eight potential moderators – six theoretically important moderators and two methodologically important moderators – that may explain these inconsistent findings (see Table S1 in Supplementary Materials for a more detailed rationale for examining these moderators). One is anxiety disorder subtype because there are numerous anxiety and depression disorders, and poor reading might be associated with some disorder subtypes (e.g., social anxiety) but not others (e.g., generalised anxiety). Another is poor reading subtype since there are numerous reading problems (i.e., poor visual word recognition, poor reading fluency) that may differentiate poor readers with and without internalising problems. A third is attention because poor attention is independently associated with both poor reading (Willcutt & Pennington, 2000) and internalising problems (Levy, Hay, Bennet, & McStephen, 2005), and research has shown that some children with

internalising problems and poor reading also have problems with poor attention (Barbosa, Tannock, & Manassis, 2002; Barriga et al., 2002; Grills-Taquechel, Fletcher, Vaughn, Denton, & Taylor, 2013). A fourth is sex as females tend to experience more problems with anxiety and depression than males (Bruce et al., 2005; Mclean, Asnaani, Litz, & Hofmann, 2011). A fifth potential moderator is age, since the prevalence of internalising disorders varies markedly across childhood, adolescence, and adulthood (Ford, Goodman, & Meltzer, 2003; Kessler et al., 2005). A sixth is ethnicity because some ethnic minorities (i.e., Native American, Latino American, Asian American, African American) experience higher rates of internalising problems than European Americans (for a review see, Anderson & Mayes, 2010), and within these groups research suggests that Latino American youth in particular experience problems with anxiety (Ginsburg & Silverman, 1996), and depression (Umana-Taylor & Updegraff, 2007). A seventh is type of informant as information on internalising problems can be gathered from young people, parents, and teachers. Each informant offers a different perspective on the internalising difficulties experienced, and these reports can also be inconsistent particularly between children and parents (Grills & Ollendick, 2002; Safford, Kendall, Flannery-Schroeder, Webb, & Sommer, 2005). The final potential moderator is type of internalising measure, because clinical interviews (i.e., categorical measures) assess for the presence or absence of an anxiety or depression disorder, while questionnaires (i.e., dimensional measures) assess for constellations of general internalising symptoms (Krueger & Eaton, 2015).

The current study

To date, there have been two literature reviews of studies that have tested poor readers for internalising problems (Maughan & Carroll, 2006; Mugnaini, Lassi, La Malfa, & Albertini, 2009). Mugnaini et al. reviewed studies on general learning disabilities (including poor reading) and general internalising problems (including anxiety and depression) and

examined whether attention and age influenced these associations. They found that poor readers of all ages are at risk for internalising problems, that poor reading is specifically associated with both anxiety and depression, and that poor readers with attention problems are at higher risk for internalising problems than poor readers without attention problems.

Maughan and Carroll (2006) reviewed three studies of poor reading and anxiety (Arnold et al., 2006; Carroll et al., 2005; Carroll & Iles, 2006), and two studies of poor reading and depression (Arnold et al., 2006; Carroll et al., 2005). Regarding the former, Carroll et al. found that poor readers were at greater risk for generalised anxiety and separation anxiety but not specific phobias, and that this increased risk was not attributable to a shared association with inattention. Similarly, Arnold et al. reported that adolescent poor readers experienced higher rates of depression, trait anxiety, and somatic problems than controls, and that this association was also not attributable to problems with inattention. Finally, Carroll and Iles discovered that poor readers had high state, trait, and social anxiety. In terms of depression, Carroll et al. found no association between depression and poor reading, while Arnold et al. found that poor reading was associated with self-reported depression, which again was not attributable to poor attention. From these findings, Maughan and Carroll suggested that poor readers are at higher risk for anxiety than typical readers, and that this risk is not explained by poor attention. However, the association between poor reading and depression is less clear since one study found higher depression in poor readers while another did not, and it is also possible that this relationship may be moderated by problems with attention.

In their day, the reviews by Maughan and Carroll (2006) and Mugnaini et al. (2009) provided important and formative synopses of the existing evidence for the association between poor reading and internalising problems. However, these reviews are now 12- and 8-years-old respectively, and each synthesised the data using a narrative analysis instead of a

meta-analysis due to lack of studies. Further, these reviews considered just one potential moderator of the association between poor reading and anxiety and depression (i.e., inattention), and neither reported the selection criteria for studies and hence cannot be replicated. Given the limitations of these foundational reviews, the primary goal of the current systematic review and meta-analysis was to determine if there is a reliable association between poor reading and internalising problems with acceptable heterogeneity between studies (Aim 1), and if so, evaluate if this reliable association is moderated by theoretical (i.e., anxiety disorder subtype, poor reading subtype, attention subtype, sex, age, ethnicity) or methodological important moderators (i.e., type of internalising measure, type of informant; Aim 2).

METHOD

This review was designed and reported in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Shamseer et al., 2015). The protocol for this review was published on the international prospective register of systematic reviews and made publicly available in order to document any discrepancies in the methods and importantly reduce bias (PROSPERO; Reference: CRD42016049219, available from <http://www.crd.york.ac.uk/PROSPERO>).

Eligibility criteria

Participants

This review included studies with “poor readers” who were children aged 6-12 years, adolescents aged 13-18 years, and adults aged 18+ years. A person or group was considered to have poor reading if they met one or more of the following criteria: Their score or mean score on a reading test was (1) at least one standard deviation below the average level for a person's age; (2) at least one year below the average level for a person's school grade; (3) statistically significantly lower than a score on an intelligence test; (4) statistically

significantly poorer than a typical reading control group. A person or group was also considered to have poor reading if they met the diagnostic criteria for reading problems specified in any edition of the DSM, such as showing: (1) a specific difficulty in learning or using academic skills specific to reading; (2) performance on a standardised reading test that is significantly lower than the level of most students the same age; (3) a reading difficulty that is apparent during the early years of schooling; and (4) a reading difficulty that has no plausible explanation such as intellectual disability or sensory impairment.

In keeping with most studies of poor reading, and the DSM criteria, we only included studies where poor readers (1) had no known medical, psychological, or neurological problem that might explain their reading difficulty – with the exception of poor attention (see below); (2) had no known general developmental or intellectual or learning delay – with the exception of additional specific learning difficulties (i.e., mathematical problems such as dyscalculia) or language problems (i.e., specific language impairment) since many poor readers experience problems in these areas, and many studies do not screen for these additional learning difficulties; (3) spoke English as their primary language - since some languages (i.e., transparent orthographies such as Dutch) are easier to learn to read accurately than others (i.e., opaque orthographies such as English; Patel, Snowling, & De Jong, 2004); and (4) had been recruited based on reading test performance rather than self-report - since research suggests that some poor readers may under-report reading difficulties (Snowling, Dawes, Nash, Hulme, 2012). As mentioned above, we included studies of poor readers with attention problems - since we wished to ascertain if this was a moderating factor. We recorded if scores on tests of inattention, hyperactivity, or the two combined were (1) if were significantly higher than a control group, (2) at least one standard deviation above the average range compared to age or grade norms, or (3) met criteria according to the DSM of any edition.

Reading data

We included studies that reported reading test data for poor phonological recoding (i.e., letter-sound identification, nonword reading accuracy), visual word recognition (i.e., sight word or irregular word reading accuracy), reading fluency (i.e., nonword or sight word fluency), and reading comprehension (i.e., understanding the meaning of text). Studies that *only* included data for poor reading comprehension were excluded since poor reading comprehension can stem from a problem with spoken language rather than a reading difficulty per se (Oakhill, Cain, & Bryant, 2003). However, we did include studies of poor readers with poor reading comprehension who also showed evidence of poor phonological recoding, visual word recognition, or reading fluency.

Internalising, anxiety, and depression data

We included studies that measured these disorders using clinical interviews or questionnaires that provided a mean raw or standardised score for general internalising symptoms (i.e., emotional distress, composite measure of anxiety and depression), anxiety symptoms (i.e., worry, state or trait anxiety) or anxiety disorder subtypes (i.e., generalised anxiety disorder), or depression symptoms (i.e., sadness) or depression disorder subtypes (i.e., major depression disorder). We considered a group of poor readers to have higher internalising problems if their mean raw or standardised score on the clinical interview or questionnaire was significantly higher than a (1) control group, (2) clinical cut-off point, or (3) the average level for a person's age according to normative data. We also considered poor readers to have higher internalising problems if they met criteria for a diagnosis of an anxiety or depression disorder (DSM any edition).

Exclusionary criteria

We excluded studies that (1) reported single case studies because effect sizes from case studies can have a disproportionate effect on mean effect sizes compared to group

studies; (2) reported data in dissertations if the same data was presented in a peer reviewed paper; (3) did not report reading test scores, which precluded us from determining whether or not poor readers' met our inclusion criteria; (4) reported composite measures of internalising and externalising problems; and (5) reported data from the same population in separate publications. In the last instance, we included the study with the largest sample size to maximise power for our analysis.

Information sources

We ran the searches for this review in July 2016 and August 2018. In July 2016, we used PsycINFO (Ovid, 1860 to July 2016), MEDLINE (Ovid, 1902 July 2016), EMBASE (Ovid, 1902 July 2016), WILEY, PubMed, Google Scholar, and PsycEXTRA for all available years. In August 2018, we used PsycINFO (Ovid, July 2016 to August 2018), MEDLINE (Ovid, July 2016 to August 2018), EMBASE (Ovid, July 2016 to August 2018), WILEY (July 2016 to August 2018), PubMed (July 2016 to August 2018), PsycEXTRA (July 2016 to August 2018), and Google Scholar for all available years. The searches were limited to human participants and studies published in English. The search strategy was adapted to meet the truncation and Boolean operations of each database. The following search strategy, which was conducted in PsycINFO, is provided as an example: “dyslexi\$.tw or reading adj1 (disord\$ or impair\$ or deficit\$ or delay\$ or dysfunction\$ or achievement\$ or difficult\$ or problem\$) or (poor adj1 (read\$ or literacy)) or (specific adj1 learning dis\$) AND (anxi\$.tw or depress\$.tw or psychosocial or internali?ing or psych\$ comorbid\$ or suicide\$”). The list of full search terms is provided in Appendix A.

Study selection

We screened the studies in six steps, using the SysRev program for data management to organise and screen the citations. In Step 1, we developed an initial set of search terms. DF (first author) developed the search terms in consultation with reading and emotional health

experts, and refined the search terms through the iterative search strategy shown in Figure 1. In Step 2, we entered the search terms into the databases. DF conducted the searches and retrieved all articles to be reviewed. In Step 3, we retrieved the studies and screened the title and abstract of all studies. Two reviewers (DF and GM [fourth author]) read the title and abstract of all studies. The reviewers accepted any study that appeared to measure the association between poor reading and internalising, anxiety, or depression based on the information provided in the title and abstract, and rejected any study that clearly did not. The reviewers were blind to the journal titles, study authors, institutions, and publication status.

In Step 4, DF downloaded the full-text portable-document-format (PDF) files from the world wide web (www) for studies that were accepted by both reviewers, as well as studies that were accepted by one reviewer but rejected by the other. If a PDF of a study could not be found on the www, a request was made through Macquarie University Library resources, or by contacting the corresponding author of the paper in question. If there was no response from the corresponding author then we contacted the co-author. The study was excluded if the full-text could not be retrieved. DF and GM examined the full text PDFs of studies retrieved in Step 4. A study was accepted if it met the aforementioned inclusion and exclusion criteria, and rejected if it did not. All decisions were recorded in an excel spreadsheet. DF compared the decisions made by the two reviewers for the accepted and rejected studies. Studies accepted by one review but rejected by the other were discussed between the two reviewers to reach a joint decision regarding inclusion. The studies that were accepted by both reviewers were included in the review.

In Step 5, we identified the number of studies that measured internalising problems, anxiety, or depression in poor readers (for precision; see Figure 1), and the number of studies that did not measure internalising problems, anxiety, or depression in poor readers (i.e., for

specificity; see Figure 1). DF compared the accepted and rejected studies from the two reviewers.

In Step 6, we screened the reference lists of the identified studies to determine if we had missed any critical studies with the search terms (i.e., sensitivity). We identified 13 missed studies (Aman, 1979; Boetsch, 1997; Chapman, Tunmer, & Prochnow, 2004; Daniel et al., 2006; Hughes et al., 2013; MacPhail, 2013; Martinez & Semrud-Clikeman, 2005; McGee, Williams, Share, Anderson, & Silva, 1986; Mercer, 2005; Murray, 1978; Sanson, Prior, & Smart, 1996; Scarborough & Parker, 2003; Snowling et al., 2007). We therefore instigated a reiterative process whereby we revised the search terms and repeated Steps 1 to 6 to see if we could capture these studies. In the first reiterative phase, we captured 9 of the 13 missing studies. In the second reiterative phase, we captured all 13 of the missing studies (see Figure 1).

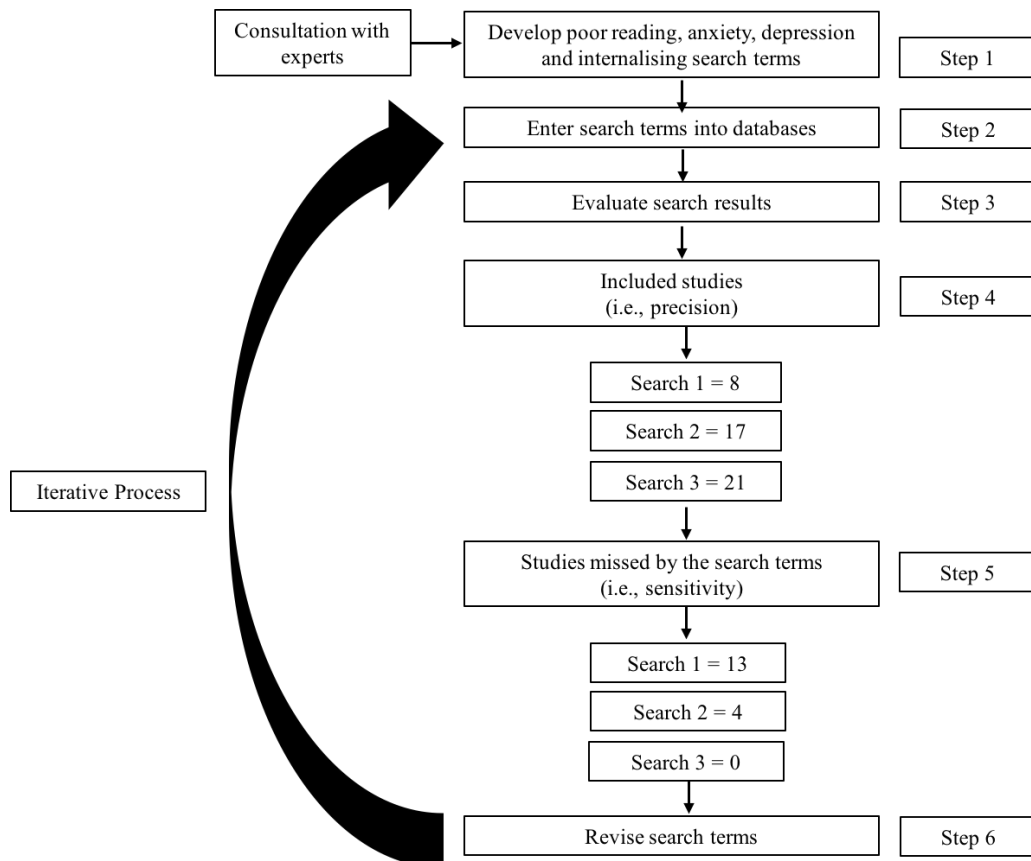


Figure 1. The reiterative search strategy process.

Data extraction

The data items extracted from each included study are displayed in Table 1. DF independently recorded the data in a customised excel data extraction form, and a second reviewer (NC; the second author) independently read the selected studies and checked the data for accuracy. There were no major discrepancies between the two reviewers. In all cases, DF and NC discussed the discrepancies with careful reference to the original article and a final decision was made. In terms of missing data, we contacted the corresponding author to request the data. If there was no response from the author in question, the co-author was contacted. If there was no response from either author, or the data was unavailable, then the study was excluded from the systematic review and meta-analysis.

Table 1

Category, name, and description of the data extracted from each study

Category	Name	Description
Source	Citation	Author, publication year, title, journal
	Publication type	Journal article, dissertation, “other” unpublished work
Eligibility	Inclusion criteria	Recruitment criteria and any neurological/medical/psychological comorbidities
	Exclusion criteria	Record why the study was excluded
Participants	Study design	Longitudinal, cross-sectional, case-control, correlation
	Sample size	Total and group sample sizes
	Poor reading	Criteria used to define reading ability of the groups
	Age and grade	Range, mean (<i>M</i>), standard deviation (<i>SD</i>) of the groups
	Sex	Number of females and males in each group
	Type of school	Public, private, learning specialist, university
	Ethnicity	Division of ethnicity for the groups
	Sociodemographic status	Highest level of education (adult participants), or mother and father education, or household income (child participants)
	Intelligence	Test scores from intelligence assessment
	Tests	Tests used to measure reading ability
Reading	Impaired	<i>M</i> , <i>SD</i> , and effect sizes on tests showing impairment
	Unimpaired	<i>M</i> , <i>SD</i> , and effect sizes on reading tests not showing impairment
Internalising	Tests	Tests used to measure internalising problem
	Internalising problem	Type of internalising, anxiety, or depression
	Subtype	The subtype measured (e.g., generalised anxiety, major depression)
	Informant	Self-, parent-, or teacher report
	Criteria	Criteria used to define internalising problems (i.e., clinical cut off score or normative data)
	Impaired	<i>M</i> , <i>SD</i> , and effect sizes on tests showing impairment
	Spared	<i>M</i> , <i>SD</i> , and effect sizes on reading tests not showing impairment
	Type of measure	Questionnaire or clinical interview
	Quotes	Quotes and theoretical motivation for the study
Theory	Quotes	Quotes and theoretical motivation for the study

Appraisal of methodological quality

Two reviewers (DF and NC) independently assessed methodological quality and risk of bias for all studies included in this review using a modified cross-sectional rating scale of the Newcastle-Ottawa Scale (NOS; Wells et al., 1996). The NOS is recommended by the Cochrane Collaboration to evaluate risk of bias for non-randomised trials (Higgins & Green, 2008). The scale comprises eight multiple-choice questions that were tailored to the characteristics of the studies included in this review. The two reviewers rated the risk of bias for each outcome (i.e., internalising problems, anxiety, depression) according to the following criteria: (1) selection of groups, which assessed the representativeness and

characteristics of the sample; (2) exposure, which assessed the comparability of participants and level of control; and (3) outcome, which assessed the quality of the outcomes and the statistical analysis of the outcomes. A maximum of nine points were assigned per study per outcome. These ratings were: low risk of bias (7 to 9 points); moderate risk of bias (4 to 6 points); and high risk of bias (0 to 3 points). In other words, low scores indicated high risk of bias. A priori, we decided that studies with low and moderate risk of bias would be included in the meta-analysis, and studies with high risk of bias would be excluded from the meta-analysis. There was moderate agreement between the two reviewers on the risk of bias ratings ($\kappa = .44$), and any discrepancies were satisfied upon discussion between the two reviewers and reference to the original study.

Data analysis

The results of the individual studies measuring the relationship between poor reading and internalising problems, anxiety, and depression were meta-analysed using the Comprehensive Meta-Analysis program (Borenstein, Hedges, Higgins, & Rothstein, 2006). We calculated Cohen's d effect sizes using the means and standard deviations for each outcome for the poor reading and control groups. If the means and standard deviations were not reported, we used the procedures of the Comprehensive Meta-Analysis program to calculate the effect size using the available data (i.e., odds ratios or proportions). If the study did not report an appropriate control group, and a standardised test with normative data was administered, we imputed the normative data (i.e., *St Sc.*, $M = 100$, $SD = 15$) and sample size of the normative population in the analysis. Hedges g was also calculated in an attempt to correct for small sample sizes (Hedges & Olkin, 1985). However, because the values of g and d were almost identical, we only reported Cohen's d as it is regularly reported in meta-analyses (Higgins & Green, 2008). Positive effect sizes were interpreted as showing higher

internalising problems, anxiety, or depression for poor readers compared to controls, and Cohen's d was interpreted as small (0.30), moderate (0.50), and large (0.80; Cohen, 1988).

We expected considerable heterogeneity between studies because of methodological differences between the studies included in this review (i.e., the studies adopted different criteria and administered different tests to measure reading and internalising problems in poor readers). Therefore, we planned to use a random effects model that accommodates the variation in effect sizes between studies (Borenstein et al., 2006). As a test of heterogeneity, we also calculated the I^2 statistic. We interpreted I^2 as showing no heterogeneity (0%), low heterogeneity (25%), moderate heterogeneity (50%), and high heterogeneity (75%; Higgins, Thompson, Deeks, & Altman, 2003).

In some studies, more than one test was administered to measure internalising problems, anxiety, or depression. For studies that reported data for multiple tests per outcome, we (1) calculated Cohen's d for each test; and (2) calculated an average Cohen's d for each outcome. Thus, there was one overall effect size for each sample in each study that measured internalising problems, anxiety, or depression. For longitudinal studies that reported outcome data across multiple time points, we calculated Cohen's d using the earliest time point at which poor reading and internalising problems, anxiety, or depression were measured concurrently. This procedure was followed to counteract the effect of any intervention on the outcomes. Finally, some studies included data for multiple groups of poor readers. In some of these studies, these groups were compared to one control group. In these cases, we combined the average data of all the poor reading groups and calculated the average Cohen's d for each outcome. In other studies, each group of poor readers had its own control group. In these cases, we considered the poor reading group and the respective control group as a single study. These procedures were followed to prevent violating the

assumption of independent data points, where greater weight is assigned to studies with multiple effect sizes (Lipsey & Wilson, 2001).

Publication bias was assessed for each outcome by visually inspecting the funnel plots, examining Egger's test (Egger, Davey Smith, Schneider, & Minder, 1997), and following the trim and fill procedure (Duval & Tweedie, 2000). The funnel plot displays the standard error on the y -axis, and the standardised mean difference on the x -axis. Egger's test determines the asymmetry of the funnel plot. And the trim and fill procedure estimates the number of missing studies ("trim"), computes artificial studies to add to the funnel plot ("fill"), and produces an unbiased estimate of the effect.

We also planned to use a series of subgroup analyses to determine if any statistically reliable association with acceptable heterogeneity was moderated by any of the eight variables outlined in the Introduction. This analysis was only planned if there were 10 or more studies per moderator. If this was not possible due to insufficient data, a narrative synthesis of the results was planned instead.

Coding of internalising problems

We extracted data for each study that measured poor reading and general internalising problems (i.e., combined anxiety and depression, general internalising problems), anxiety symptoms and disorders (i.e., overall anxiety; generalised anxiety), and depression symptoms and disorders (i.e., sadness; major depression disorder).

Coding of moderators

Anxiety disorder subtype. Studies were separated into five groups based on the anxiety disorder subtype, including (1) generalised anxiety; (2) separation anxiety; (3) social anxiety; (4) specific phobias; and (5) panic disorder. It is noteworthy, that while this review includes studies of general anxiety, trait anxiety, state anxiety, and test anxiety, these types of

anxiety are not considered to be disorders according to the DSM-5, and hence were not included as subgroups of anxiety disorder subtype.

Depression disorder subtype. Studies were separated into three groups based on the depression disorder subtype examined, including (1) major depression disorder, (2) persistent depression disorder; and (3) disruptive mood dysregulation disorder.

Poor reading subtype. Studies were separated into four groups based on the type of reading problem: (1) phonological recoding; (2) visual word recognition; (3) reading fluency; and (4) mixed poor reading (i.e., any combination of 1 to 3).

Attention subtype. Studies were separated into three groups based on the type of attention problems that poor readers experienced: (1) inattention, defined by difficulty maintaining attention, short attention span, and distractibility; (2) hyperactivity, defined by impulsivity and difficulty regulating attention; and (3) combined attention problems, defined by difficulties with inattention and hyperactivity.

Sex. Studies were separated into three groups based on differences between the numbers of males (M) and females (F) in the sample: (1) more than 10 males than females ($M > F$); more than 10 females than males ($F > M$); and (3) equal numbers of males and females ($M = F$). We used 10 as a minimum difference between sexes since it ensured a substantial imbalance in the number of males and females in the samples included in this review.

Age. Studies were separated into three groups based on the age of participants: (1) children aged 6 to 12 years; (2) adolescents aged 13 to 18 years; (3) adults aged 18 years and above; and (4) mixed age, comprising any combination of 1 to 3.

Ethnicity. Studies were separated into four groups based on the number of participants identified as (1) more than 60% of the sample were Caucasian; (2) more than

60% of the sample were African-American; (3) more than 60% of the sample were Hispanic; and (4) there were mixed ethnicities reported in the sample (i.e., any combination of 1 to 3).

Type of informant. Studies were separated into four groups based on the informant, including (1) self-reports, where the individual reports on their own internalising problems; (2) parent-reports, where the parent reports on their child or adolescent's internalising problems; (3) teacher-reports, where the teacher reports on a child or adolescent's internalising problems; and (4) multi-informant reports, where a combination of 1 to 3 was administered.

Type of internalising measure. Studies were separated into two groups based on the type of measure administered, including (1) questionnaires that assess for general internalising symptoms, and (2) clinical interviews that assess for the presence or absence of anxiety or depression disorders.

RESULTS

Study selection

Two systematic literature searches were conducted for this review. In the initial search in July 2016, our search identified a total of 5,058 articles. Having removed 1,448 duplicates, we screened the titles and abstracts of the remaining 3,610 articles against the inclusion criteria. We identified 283 potentially relevant articles, and excluded 3,327 articles as irrelevant (i.e., via screening the titles and abstracts of each study). We excluded a further 250 articles (i.e., following review of the individual PDF). This left us with 30 studies from 27 articles (Note. Two studies [i.e., manuscripts] included more than one study with separate participants; Boetsch et al., 1999; Miller et al., 2005).

In the search in August 2018, our search identified a total of 1,272 articles. We removed 101 duplicates, leaving us with 1,171 titles and abstracts to compare against the inclusion criteria. We excluded 1,143 articles, leaving 28 potentially relevant articles. We

excluded a further 25 articles. This left us with 34 studies in total from 30 articles (see Appendix B for the articles included in this review).

Risk of bias within studies

Two authors, DF and NC, independently evaluated the 34 studies included in this review for risk of bias. Sixty-seven risk of bias ratings were assigned, and the ratings ranged from moderate to low risk of bias (see Table 2 for the risk of bias ratings for each study). The 34 studies included in this review ranged from low to moderate risk of bias and no study was excluded for high risk of bias.

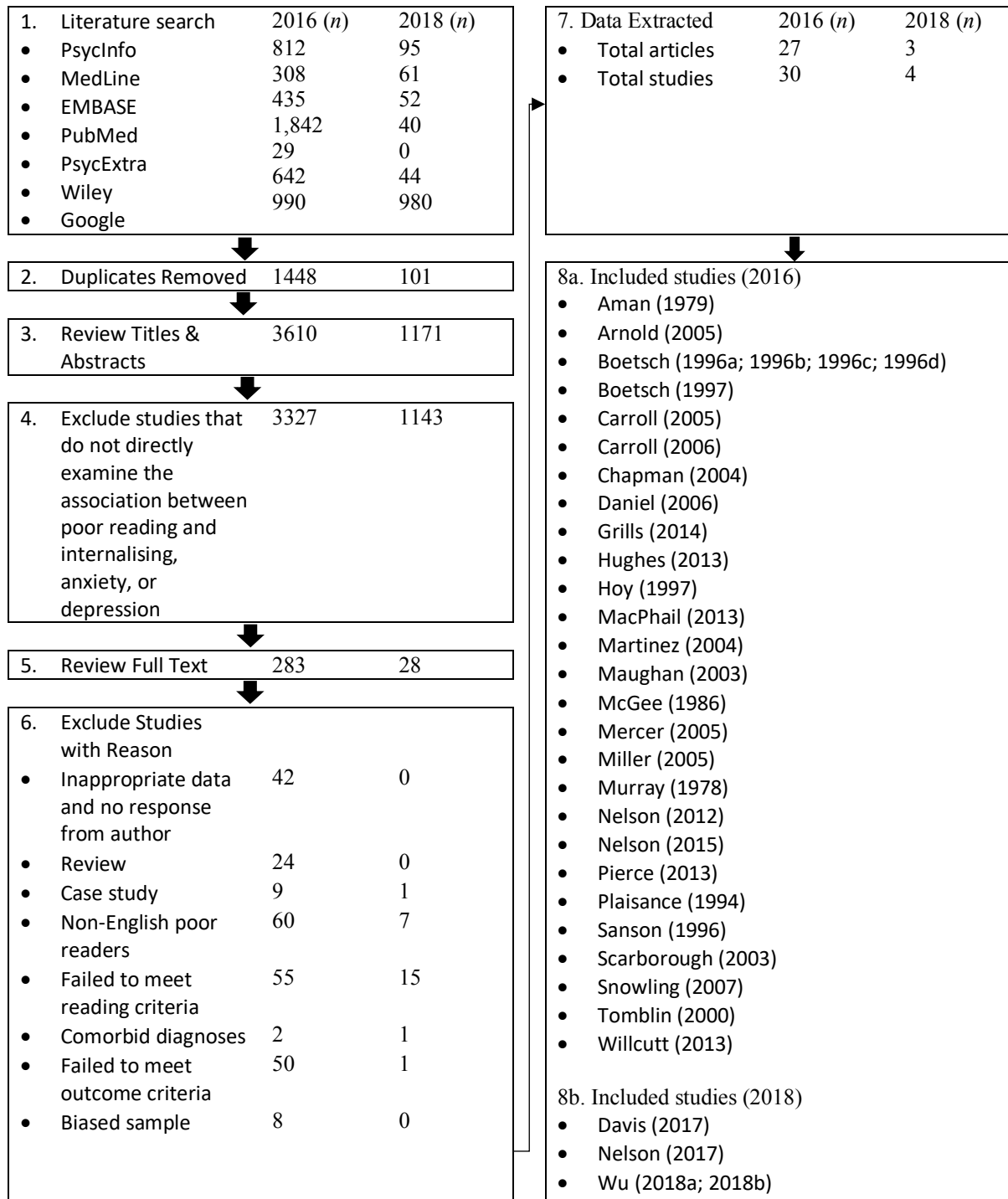


Figure 2. The study selection process showing the number of studies retrieved, excluded, and included in the meta-analysis.

Table 2

The risk of bias ratings assigned to each included study (higher stars indicate lower risk of bias) using the Newcastle Ottawa Scale.

	Sample characteristics					Outcome assessment			Statistical tests			Total risk of bias		
	Representativeness	Sample size	Response rate	Measurement tool	Controlled factors	Anxiety	Depression	Internalising	Anxiety	Depression	Internalising	Anxiety	Depression	Internalising
Aman, 1979	*	b	*	**	**	*			*			8		
Arnold, 2005	*	b	*	**	**	c	c	c	*	*	*	7	7	7
Boetsch, 1997	c	b	c	**	*		d		*	*			4	
Boetsch, 1996a	c	b	c	**	**	c	c	c	*	*	*	5	5	5
Boetsch, 1996b	c	b	c	**	**		c		*	*			5	
Boetsch, 1996c	*	b	c	**	**	*	c	*	*	*	*	7	6	7
Boetsch, 1996d	*	b	c	**	**	*	*	c	*	*	*	7	7	6
Carroll, 2005	*	b	*	**	**	*	*	*	*	*	*	8	8	8
Carroll, 2006	*	b	c	**	**	c			*			6		
Chapman, 2004	*	b	c	**	*	d	d	d	*	*	*	5	5	5
Daniel, 2006	*	b	*	**	**		*		*	*			8	
Davis, 2017	c	b	c	**	**	c			b			4		
Grills, 2014	*	b	*	**	**	c			*			7		
Hoy, 1997	c	b	c	**	**	c	c		*	*		5	5	
Hughes, 2013	c	b	c	**	*		c		*	*			4	
MacPhail, 2013	c	*	c	**	**		c		*	*			6	
Martinez, 2004	*	b	c	**	*	c	c	c	*	*	*	5	5	5
Maughan, 2003	c	*	*	**	**		c		*	*			7	
McGee, 1986	*	*	*	**	**	d	d		*	*		8	8	
Mercer, 2005	*	b	*	**	*	c	c		*	*		6	6	
Miller, 2005	c	b	c	**	**	*	*	d	*	*	*	6	6	5
Murray, 1978	c	b	c	**	**	c	d		*	*		5	5	
Nelson, 2017	c	b	c	**	**	c	c		*	*		5	5	
Nelson, 2015	c	b	c	**	**	c			*	*		5		
Nelson, 2012	*	b	c	*	**	c	c		*	*		5	5	
Pierce, 2013	*	b	c	**	**	d		d	*	*	*	6		6
Plaisance, 1994	*	b	b	**	**	d	*		*	*		6	7	
Sanson, 1996	c	b	*	**	**	d			*	*		6		
Scarborough, 2003	c	b	*	**	**			d		*				6
Snowling, 2007	c	b	*	**	**			d		*				6
Tomblin, 2000	*	b	*	**	**			d		*				7
Willcutt, 2013	*	*	c	**	**	*	*	*	*	*	*	8	8	8
Wu, 2018a	c	b	c	**	**	*	*	d	*	*	*	6	6	5
Wu, 2018b	c	*	c	**	**	d	d	d	*	*	*	6	6	6

Note. Representativeness (* = truly or somewhat representative of the average in the target population; c = selected group of users; d = no description of the sampling strategy); sample size (* = justified and satisfactory; b = not justified); non-respondents (* = satisfactory response rate >60%; b = unsatisfactory response rate <60%; c = no description of the response rate); poor reading (** = validated measurement tool; b = non-validated measurement tool, but the tool is available or described; c = no description of the measurement tool); control (** = English poor readers and additional factors controlled; * = English poor readers only with no additional factors controlled); outcome assessment for anxiety, depression, internalising (* = interview, or self and parent or teacher report; c = self-report; d = parent or teacher report); statistical tests for anxiety, depression, internalising (* = statistical test is clearly described and appropriate; b = statistical test is inappropriate, incomplete or not described); total risk of bias rating /9 for anxiety, depression, internalising.

Study characteristics

The characteristics of the 34 studies included in this review are shown in Appendix C. Of these, 25 studies were conducted in the US (82%), five in Europe (14%), and three in New Zealand and one in Australia (11%). There were eight longitudinal studies, 24 cross-sectional studies, and two treatment studies. There were 25 journal articles and five dissertations. Some studies tested poor readers for more than one type of internalising problem. For example, there were 14 studies comprising 12,092 participants ($n = 1,147$ poor readers) that measured general internalising problems in poor readers. There were 22 studies comprising 11,372 participants ($n = 1,732$ poor readers) that measured anxiety in poor readers. There were 23 studies comprising 10,714 participants ($n = 1,950$ poor readers) that measured depression in poor readers. Table 3 summarises the size of the effects between poor reading and control groups for each of these general internalising problems, anxiety, and depression. In terms of the measures administered, most studies assessed internalising problems, anxiety, and depression using questionnaires rather than clinical interviews (with the exception of three studies: Carroll et al., 2005; Willcutt et al., 2013; Wu, 2018). There were numerous questionnaires administered. The most common measure of general internalising problems was the Child Behaviour Checklist (CBCL; Achenbach, 1991), which was administered in seven of 14 internalising studies (Arnold et al., 2005; Boetsch et al., 1996c; Chapman et al., 2004; Scarborough & Parker, 2003; Tomblin et al., 2000; Wu, 2018a; 2018b). The three most common measures of anxiety were the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983; Arnold et al., 2005; Carroll & Iles, 2006; Hoy, 1997), the Multidimensional Anxiety Scale for Children (MASC; March, 1997; Grills et al., 2014; Mercer, 2005; Murray, 1978), and the CBCL (Arnold et al., 2005; Chapman et al., 2004; Wu, 2018b) – each administered in three anxiety studies. The most common measure of depression was the Child Depression Inventory (CDI; Kovacs, 1992), which was administered in five of 23

depression studies (Boetsch et al., 1996c; Boetsch et al., 1996d; Boetsch, 1997; Hughes, 2013; Miller et al., 2005). It is important to note that different measures were used to measure these internalising problems, and these differences can make comparisons between studies difficult, which we consider further in the Discussion.

Participant characteristics

In studies that reported age, the mean age of poor readers was 15.07 years. Most studies included samples of both male and female participants, but the total proportion of poor readers included more male (68.37%) than female participants (31.62%). Few studies reported the ethnicity of participants included in their sample. For studies that did report this information, studies recruited poor readers who were mostly Caucasian (35.30% of included studies), African-American (5.88% of included studies), Hispanic (2.94 % of included studies), or mixed ethnicity (8.82% of included studies). It is difficult to determine whether any ethnic groups were underrepresented in the included studies, as 16 of 34 studies (48.05%) failed to report ethnicity of the sample. As defined by the Eligibility Criteria, all studies included in this review recruited participants with English as their primary language.

Table 3

The standardised mean difference (Cohen's d) and 95% confidence intervals (95% CI) for poor reading (PR) and control (C) groups for included studies that measured the association between poor reading and internalising problems, anxiety, or depression

Study	N		Anxiety			Depression			Internalising		
	PR	C	Cohen's	95% CI		Cohen's	95% CI		Cohen's	95% CI	
			d	Lower	Upper	d	Lower	Upper	d	Lower	Upper
Aman, 1979	28	28	0.59*	0.06	1.11						
Arnold, 2005	94	94	0.45*	0.15	0.73	0.51**	0.21	0.80	0.19	-0.09	0.48
Boetsch, 1997	28	38				0.38	-0.11	0.87			
Boetsch, 1996a	18	18				0.46	-0.20	1.122	0.88*	0.19	1.56
Boetsch, 1996b	70	67				-0.51*	-0.84	-0.16			
Boetsch, 1996c	26	26				-0.25	-0.80	0.31	0.52	-0.03	1.07
Boetsch, 1996d	98	118				-0.01	-0.27	0.26			
Carroll, 2005	289	5463	0.59*	0.14	1.02	0.08	-0.32	0.48	0.45**	0.33	0.57
Carroll, 2006	16	16	1.35*	0.56	2.15						
Chapman, 2004	38	55	0.21	-0.20	0.62	0.70**	0.27	1.13	0.40	-0.01	0.82
Daniel, 2006	94	94				0.52*	0.09	0.95			
Davis, 2017	22	21	0.86*	0.24	1.49						
Grills, 2014	73	31	-0.07	-0.49	0.34						
Hoy, 1997	184	140	0.16	0.61	0.50	0.28**	0.72				
Hughes, 2013	19	21				0.43	-0.20	1.05			
MacPhail, 2013	58	67				0.20	-0.15	0.55			
Martinez, 2004	30	30	0.14	-0.37	0.64	0.39	-0.11	0.90	0.33	-0.17	0.84
Maughan, 2003	134	1282				0.61**	0.27	0.94			
McGee, 1986	40	436	0.46	-0.01	0.93						
Mercer, 2005	25	56	-0.15	-0.62	0.32	-0.20	-0.67	0.26			
Miller, 2005	20	59	0.41	-0.06	0.90	0.18	-0.30	0.66	-0.06	-0.55	0.41
Murray, 1978	104	104	0.21	-0.06	0.48	-0.30*	-0.57	-0.02			
Nelson, 2017	110	110	-0.02	-0.28	0.25	0.23	-0.04	0.49			
Nelson, 2015	50	50	0.41*	0.02	0.81						
Nelson, 2012	90	60	0.11	-0.21	0.44	-0.09	-0.41	0.23			
Pierce, 2013	47	1983	0.91**	0.62	0.20				0.61**	0.32	0.90
Plaisance, 1994	50	58	0.88**	0.48	1.27	0.56*	0.18	0.95			
Sanson, 1996	232	42	0.97**	0.57	1.37						
Scarborough, 2003	44	28							0.35	-0.24	0.93
Snowling, 2007	21	17							0.86*	0.18	1.53
Tomblin, 2000	174	2368							0.35**	0.19	0.50
Willcutt, 2013	429	419	0.52**	0.21	0.81	0.93**	0.49	1.37	0.56**	0.40	0.72
Wu, 2018a	9	141	-0.25	-0.93	0.42	-0.01	-0.68	0.67	0.59	-0.09	1.27
Wu, 2018b	121	244	0.44*	0.22	0.66	0.32*	0.09	0.54	0.11	-0.01	0.42

Note. * $<.05$; ** $<.001$

Meta-analysis of the association between poor reading and internalising problems**Main analysis**

Fourteen included studies provided data on the association between poor reading and internalising problems. Figure 3 shows the 14 effect sizes from 14 studies comparing the standardised mean difference and 95% CIs between poor reading and control groups on measures of internalising problems (n poor reading groups = 14, sample size = 1,147, mean sample size = 81.93; n control groups = 14, total sample size = 10,945, mean sample size = 781.79). The overall effect was positive, moderate, and statistically significant ($d = 0.41$), 95% CI [0.31, 0.51], $p < .001$, and low heterogeneity was also present $I^2 = 35.07\%$, $Q(13) = 20.02$, $p > .05$.

Subgroup analysis

We could not conduct any of the planned subgroup analyses because there were fewer than 10 studies per subgroup, precluding any reliable comparison of effect sizes between subgroups for each potential moderator. The studies that examined the association between poor reading and internalising problems, and the number of studies examining each moderator are shown in Table S2 in the Supplementary Materials. We provide a narrative analysis of the evidence for the studies representing these moderators in the Discussion.

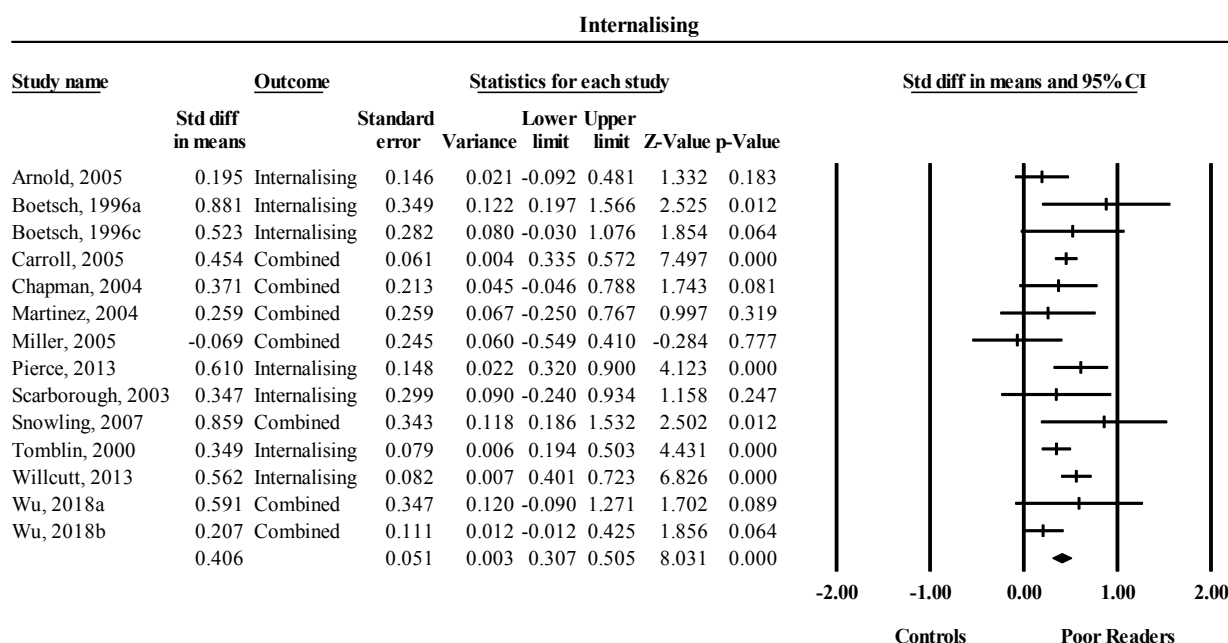


Figure 3. Random effects forest plot showing the standardised mean difference and 95% CIs for each study on the association between poor reading and general internalising problems.

Meta-analysis of the association between poor reading and anxiety

Main analysis

Twenty-two included studies provided data regarding the association between poor reading and anxiety. Figure 4 shows the 22 effect sizes comparing the standardised mean difference and 95% CIs between poor reading and control groups on measures of anxiety (n poor reading groups = 22, sample size = 1,732, mean sample size = 78.73; n control groups = 22, sample size = 9,640, mean sample size = 438.18). The overall effect was moderate, positive, and statistically significant ($d = 0.41$), 95% CI [0.26, 0.55], $p = < .001$, and there was also evidence for moderate heterogeneity, $I^2 = 68.39\%$, $Q(21) = 66.43$, $p < .001$.

Subgroup analysis

It was not possible to conduct any of the planned subgroup analyses because there were fewer than 10 studies per subgroup for each moderator. The studies that examined the association between poor reading and anxiety, and the number of studies examining each moderator variable are shown in Table S3 in the Supplementary Materials. Again, we provide

a narrative synthesis of the evidence for these moderators on the relationship between poor reading and anxiety in the Discussion.

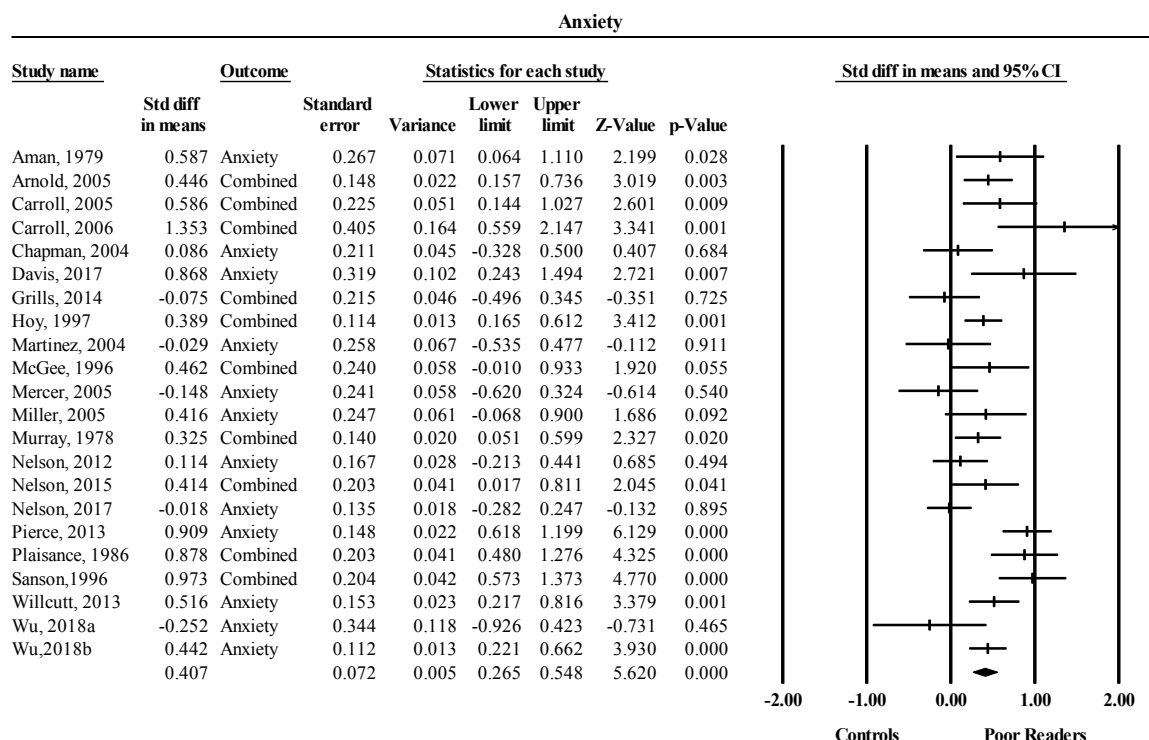


Figure 4. Random effects forest plot showing the standardised mean difference and 95% CIs for each study on the association between poor reading and anxiety.

Meta-analysis of the association between poor reading and depression

Main analysis

Twenty-three included studies provided data on the association between poor reading and depression that were included in the meta-analysis. Figure 5 shows the 23 effect sizes comparing the standardised mean difference and 95% CIs between poor reading and control groups on measures of depression (n poor reading groups = 23, sample size = 1,950, mean sample size = 84.78; n control groups = 23, sample size = 8,764, mean sample size = 381.04). The overall effect was very small but significant ($d = 0.23$), 95% CI [0.07, 0.37], $p < .05$, and there was also evidence for high and significant heterogeneity, $I^2 = 74.51$, $Q(22) = 86.33$, $p < .001$.

Subgroup analysis

We could not carry out the planned subgroup analyses on the potential moderators of the association between poor reading and depression because the small mean effect size, though statistically significant, was associated with high and significant heterogeneity found between studies.

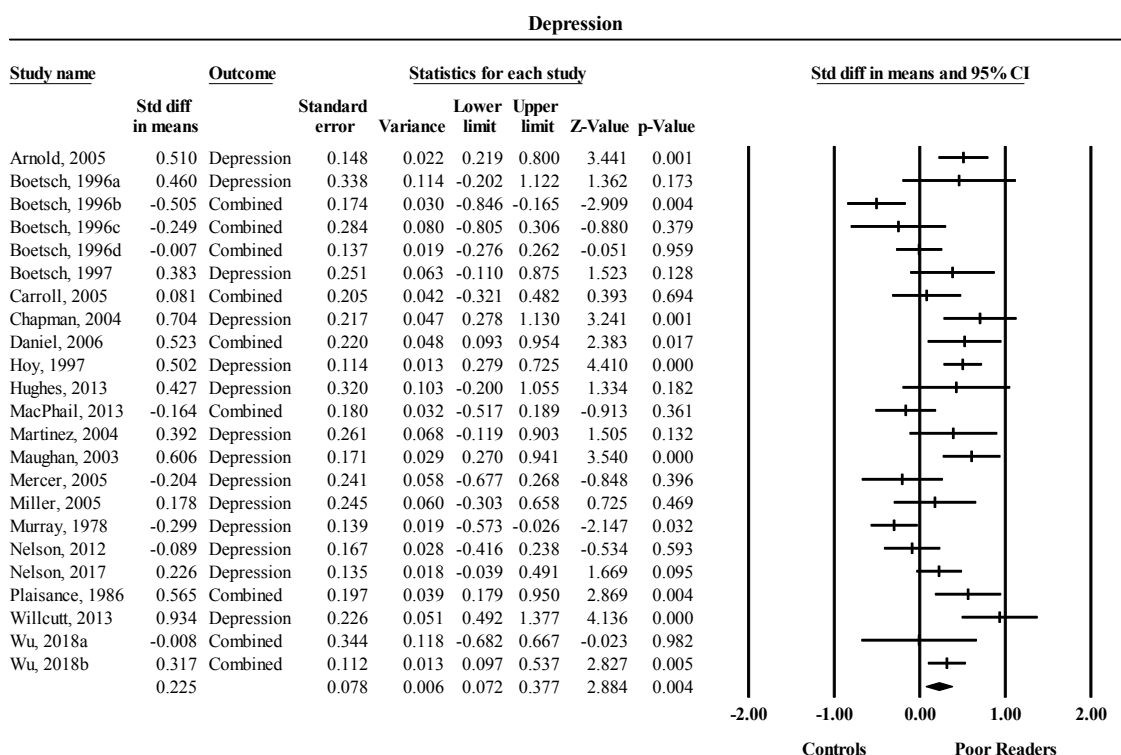
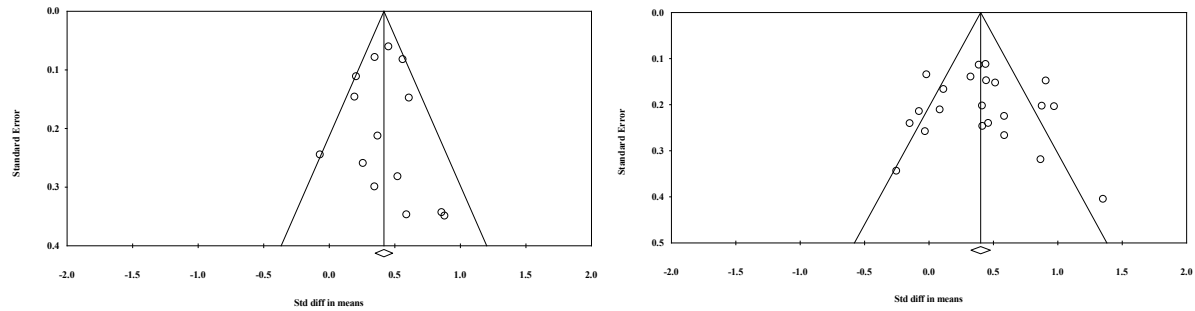


Figure 5. Random effects forest plot showing the standardised mean difference and 95% CIs for each study on the association between poor reading and depression.

Risk of bias across studies: Publication bias

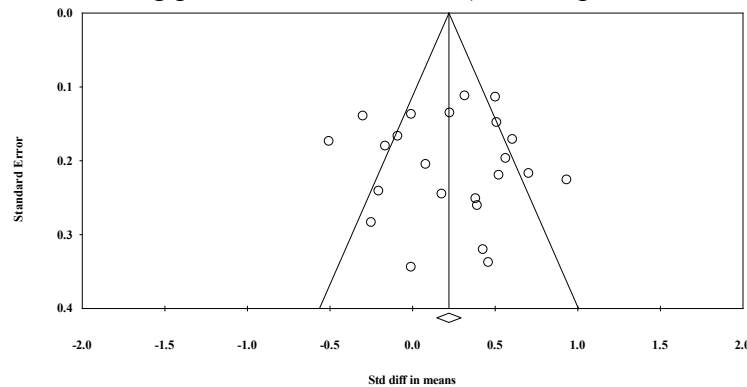
We evaluated the likelihood of publication bias by visually inspecting the random effects funnel plots for studies that measured the association between poor reading and general internalising problems, anxiety, and depression, with the standard error plotted on the y-axis and the standardised mean difference plotted on the x-axis (see Figure 6). The funnel plots showed symmetry, and evaluation of Egger's test showed that publication bias was not present for internalising problems, $t(12) = 0.05$, $p > .05$, 95% CI [-1.42, 1.35], anxiety, $t(20)$

= 0.25, $p > .05$, 95% CI [-2.22, 2.85], or depression, $t(21) = 0.10$, $p > .05$, 95% CI [-2.69, 2.98]. This suggests that there was no systematic difference between studies that found stronger and weaker associations between poor reading and internalising problems, anxiety, or depression



a) funnel plot for internalising problems

b) funnel plot for anxiety



c) funnel plot for depression

Figure 6. Funnel plots showing symmetrical distribution of studies measuring internalising problems (a), anxiety (b), and depression (c).

DISCUSSION

The primary goal of this systematic review and meta-analysis was to determine if there were reliable associations between poor reading and internalising problems, anxiety, and depression (Aim 1), and if so, examine if any association was moderated by theoretical (i.e., anxiety disorder subtype, poor reading subtype, attention subtype, sex, age, ethnicity) or methodological moderators (i.e., type of internalising measure, type of informant; Aim 2). Below, we use the outcomes of the meta-analysis to evaluate the association between poor

reading and internalising problems, poor reading and anxiety, and poor reading and depression, respectively. We also offer a narrative discussion of the moderators evaluated in this review, discuss the clinical and theoretical implications of these outcomes, as well as discuss the potential limitations of the current review. We offer suggestions for how these limitations might be addressed by future research.

Poor reading and internalising problems

Although based on a relatively small number of studies ($n = 14$), the results of the meta-analysis revealed a statistically significant and moderate association between poor reading and internalising problems, with moderate heterogeneity between studies. These results suggest that poor readers may, on average, experience elevated internalising problems compared to people without reading difficulties. Our results are consistent with the previous narrative reviews that examined associations between general learning disabilities (including poor reading) and internalising problems (including anxiety and depression; Maughan & Carroll, 2006; Mugnaini et al., 2009). Together, the outcomes of these reviews suggest that poor readers, on average, are at increased risk for experiencing overall general internalising problems.

Poor reading and anxiety

Again, based on a small number of studies ($n = 22$), we found a statistically-significant and moderate association between poor reading and anxiety, with moderate heterogeneity between studies. Similar to the outcomes for general internalising problems, these results indicated that poor readers experience greater problems with anxiety than typical readers. This is again consistent with the previous narrative reviews in this field, which found that poor readers of all ages are at higher risk for anxiety than typical readers (Mugnaini et al., 2009), and that poor readers are also at risk of anxiety independent of problems with poor attention (Maughan & Carroll, 2006).

Poor reading and depression

The association between poor reading and depression was also based on a small number of studies ($n = 23$). The results of the meta-analysis revealed a small but statistically significant association between poor reading and depression that was associated with high heterogeneity between studies. This finding suggests that the association between poor reading and depression is less reliable and more complex than the association between poor reading and internalising problems (i.e., composite measure of anxiety and depression) or anxiety (i.e., anxiety alone). It also suggests that the moderate and reliable association between poor reading and internalising problems ($d = 0.41$, $p < .001$, $I^2 = 35.07\%$) may more closely reflect the moderate but stable association between poor reading and anxiety ($d = 0.41$, $p < .001$, $I^2 = 68.38\%$) than the weak and unstable (yet statistically reliable) association between poor reading and depression ($d = 0.23$, $p < .05$, $I^2 = 74.51\%$). This evidence converges and clarifies the results from the previous narrative reviews in this field, whereby Mugnaini et al. (2009) suggested that poor readers are at higher risk for depression, while Maughan and Carroll (2006) suggested that the relationship between poor reading and depression is less clear. The outcomes of all these reviews converge to suggest that the association between poor reading and depression may be more complex than the association with anxiety.

Theoretical moderators

The secondary aim of this review was to conduct subgroup analyses to investigate potential moderators of any reliable associations between poor reading and internalising problems with acceptable heterogeneity between studies. In the current review, we found such an association between poor reading and anxiety. However, we were unable to conduct

any subgroup analyses because there were fewer than 10 studies per subgroup for each moderator. We therefore offer a cautious synopsis of the existing evidence relating to potential moderators of the association between poor reading and anxiety.

Anxiety disorder subtype

Of the 22 anxiety studies, only three examined anxiety disorder subtypes: All three studies examined generalised anxiety (Carroll et al., 2005; Willcutt et al., 2013; Wu, 2018a), and one also examined separation anxiety (Carroll et al., 2005). Two studies found higher anxiety for poor readers than controls (Carroll et al., 2005; Willcutt et al., 2013), while one did not (Wu, 2018a). This evidence, albeit extremely limited, suggests that poor reading is associated with both generalised and separation anxiety disorder subtypes.

Poor reading subtype

All of the anxiety studies in this review reported the type of poor reading. Eighteen studies included samples with mixed poor reading (Aman, 1979; Arnold et al., 2005; Chapman et al., 2004; Davis et al., 2017; Grills et al., 2014; Hoy, 1997; Martinez & Semrud-Clikeman, 2004; McGee et al., 1986; Miller et al., 2005; Murray, 1978; Nelson et al., 2015; Nelson & Gregg, 2012; Nelson & Liebel, 2017; Plaisance, 1994; Sanson et al., 1996; Willcutt et al., 2013; Wu, 2018a; 2018b). Two studies tested poor readers for visual word recognition only (Carroll et al., 2005; Mercer, 2005) and two studies tested their reading fluency only (Carroll & Iles, 2006; Pierce et al., 2013). There were no studies that tested poor readers for phonological recoding only. All bar six of the 18 “mixed” reading studies found higher anxiety for poor readers than controls (Chapman et al., 2004; Grills et al., 2014; Martinez & Semrud-Clikeman, 2004; Nelson & Gregg, 2012; 2017; Wu, 2018a), as did one study that tested visual word recognition only (Mercer, 2005). Both studies that tested reading fluency only found higher anxiety for poor readers than controls. Overall, the existing evidence does

not suggest that poor reading subtype moderates the association between poor reading and anxiety. However, additional research including the distinct subtypes of poor readers is needed to investigate this association further.

Attention subtype

Of the 22 anxiety studies, 11 provided details on whether poor readers had problems with attention. Three of these studies included poor readers with inattention problems (Aman, 1979; Pierce et al., 2013; Wu, 2018a), two with hyperactivity problems (Carroll et al., 2005; Wu, 2018b), and five with combined attention problems (Arnold et al., 2000; Chapman et al., 2004; McGee et al., 1986; Plaisance, 1994; Willcutt et al., 2013). One study excluded poor readers with poor attention (Davis et al., 2017). All bar one of the inattention and hyperactivity studies found an association between poor reading and anxiety (Wu, 2018a), and all bar one of the combined inattention and hyperactivity studies (Chapman et al., 2004) reported higher anxiety for poor readers than controls. Considered together, the weight of evidence does not suggest that attention subtype has a moderating role in the association poor reading and anxiety, but does suggest that there is an association between poor reading, anxiety, and poor attention overall.

Sex

There were 18 anxiety studies that reported the sex of poor readers in their sample. Eleven of these studies recruited more males than females (Aman, 1979; Arnold et al., 2005; Carroll et al., 2005; Hoy, 1997; McGee, 1986; Mercer, 2005; Miller et al., 2005; Murray, 1978; Pierce, 2013; Plaisance, 1994; Willcutt et al., 2013), two recruited more females than males (Carroll & Iles, 2006; Nelson & Liebel, 2017), and five recruited similar numbers of males and females (Grills et al., 2014; Martinez & Semrud-Clikeman, 2004; Nelson et al., 2015; Nelson & Gregg, 2012; Sanson et al., 1996). All bar one study with majority of males (10 of 11 studies). One study with more females found higher anxiety for poor readers than

controls (Carroll & Iles, 2006), while the other did not (Nelson & Liebel, 2017). The existing evidence therefore suggests that sex does not moderate the association between poor reading and anxiety. However, this suggestion is made with great caution given the extremely limited number of studies that recruited mostly females.

Age

All of the studies included in this review specified the age of their sample. There were 11 studies that recruited children aged 6 to 12 years (Aman, 1979; Chapman et al., 2004; Davis et al., 2017; Grills et al., 2014; McGee et al., 1986; Murray, 1978; Pierce et al., 2013; Plaisance, 1994; Sanson et al., 1996; Wu, 2018a; 2018b), three that recruited adolescents aged from 13 to 18 years (Arnold et al., 2005; Martinez & Semrud-Clikeman, 2004; Mercer, 2005), four that recruited adults aged 18 years and over (Carroll et al., 2006; Hoy, 1997; Nelson et al., 2015; Nelson & Liebel, 2017), and four that recruited mixed samples of children and adolescents (Carroll et al., 2005; Miller et al., 2005; Nelson & Gregg, 2012; Willcutt et al., 2013). All bar three of the child studies (Chapman et al., 2004; Grills et al., 2014; Wu, 2018a), and two of the adolescent studies (Martinez & Semrud-Clikeman, 2004; Mercer, 2005), found higher anxiety for poor readers than controls. All bar one of the mixed age studies reported an association between poor reading and anxiety (Nelson & Gregg, 2012). All bar one of the adult studies found higher anxiety for poor readers than controls (Nelson & Liebel, 2017). En masse, this evidence supports Mugnaini et al.'s (2009) conclusion that poor readers of all ages are at risk for anxiety.

Ethnicity

Fourteen studies described the ethnicity of their sample. There were 10 studies that recruited predominantly Caucasian participants (Aman, 1979; McGee, 1986; Miller et al., 2005; Nelson et al., 2015; Nelson & Gregg, 2012; Nelson & Liebel, 2017; Plaisance, 1994; Willcutt et al., 2013; Wu, 2018a; 2018b), one study that recruited predominantly African-

American participants (Grills et al., 2014), and Hispanic participants (Pierce et al., 2013), and two studies that recruited samples with mixed ethnicities (Arnold et al., 2005; Martinez & Semrud-Clikeman, 2004). The studies with mixed ethnicities and Hispanic samples found higher anxiety for poor readers than controls, as did all but three studies with majority Caucasian participants (Nelson & Gregg, 2012; Nelson & Liebel, 2017; Wu, 2018a). The study with a mostly African-American sample did not find evidence for an association between poor reading and anxiety (Grills et al., 2014). Altogether, this evidence suggests that ethnicity may not moderate the association between poor reading and anxiety.

Methodological moderators

Type of informant

Each of the anxiety studies specified the type of informant who reported anxiety. Eleven of these studies relied on self-report (Arnold et al., 2005; Carroll & Iles, 2006; Davis et al., 2017; Grills et al., 2014; Hoy, 1997; Martinez & Semrud-Clikeman, 2004; Mercer, 2005; Murray, 1978; Nelson et al., 2015; Nelson & Gregg, 2012; Nelson & Liebel, 2017), two on parent-report (Willcutt et al., 2013; Wu, 2018a), three on teacher-report (Aman, 1979; Chapman et al., 2014; Pierce et al., 2013), and six on multi-informant reports (Carroll et al., 2005; McGee et al., 1986; Miller et al., 2005; Plaisance, 1994; Sanson et al., 1996; Wu, 2018b). All but five of the self-report studies found higher anxiety for poor readers than controls (Grills et al., 2014; Martinez & Semrud-Clikeman, 2004; Mercer, 2005; Nelson & Gregg, 2012; Nelson & Liebel, 2017), as did one of the teacher-report studies (Chapman et al., 2004). One of the parent report studies found an association between poor reading and anxiety (Willcutt et al., 2013) while the other did not (Wu, 2018a). All of the studies with multi-informant reports found an association between poor reading and anxiety. Thus, the current evidence suggests that the type of informant may not moderate the association between poor reading and anxiety.

Type of anxiety measure

Finally, all of the anxiety studies described the type of anxiety measure used to assess levels of anxiety. There were 19 studies that measured anxiety using questionnaires (Aman, 1979; Arnold et al., 2005; Carroll & Iles, 2006; Chapman et al., 2004; Davis et al., 2017; Grills et al., 2014; Hoy et al., 1997; Martinez & Semrud-Clikeman, 2004; McGee et al., 1986; Mercer, 2005; Miller et al., 2005; Murray, 1978; Nelson et al., 2015; Nelson & Gregg, 2012; Nelson & Liebel, 2017; Plaisance, 1994; Pierce et al., 2013; Sanson et al., 1996; Wu, 2018b), and three studies that measured anxiety using clinical interviews (Carroll et al., 2005; Willcutt et al., 2013; Wu, 2018a). All but six of the 19 questionnaire studies found higher anxiety for poor readers than controls (Chapman et al., 2004; Grills et al., 2014; Martinez & Semrud-Clikeman, 2005; Mercer, 2005; Nelson & Gregg, 2012; Nelson & Liebel, 2017), and all but one of the clinical interview studies reported higher anxiety for poor readers than controls (Wu, 2018a). These findings suggest that type of anxiety measure is not a moderator of the association between poor reading and anxiety.

Clinical implications

In the first instance, identifying the association between poor reading and anxiety has clinical implications for understanding that some children may experience both of these common developmental disorders. Indeed, this is particularly important for educators who may be the first to identify these difficulties in children in the classroom. Hence, educators should be aware that poor reading and anxiety may co-occur in some children and use the outcomes from this study to refer children for support of their reading and anxiety problems as early as possible.

This review has clinical implications regarding accurate assessment of anxious poor readers. It suggests that some poor readers reliably experience anxiety, and hence clinicians should assess poor readers for problems with anxiety. This could be done by assessing for

general symptoms of anxiety (i.e., questionnaires that correspond with DSM anxiety disorders; MASC; March et al., 1997; Spence Children's Anxiety Scale; Spence, 1998), as well as assessing for clinical anxiety disorders (i.e., clinical interviews such as the ADIS: IV-C/P; Silverman & Albano, 1996). However, it is unfortunately unclear from our synopsis whether any of the moderators could be used to predict which poor readers might also have problems with anxiety.

The outcomes of this review also have clinical implications in terms of intervention for anxious poor readers. Specifically, the results clearly demonstrate that poor readers are at increased risk for anxiety. While only one treatment study was identified by this review (Grills et al., 2014), the overall results suggest that anxious poor readers should be referred for treatment that targets their poor reading and anxiety. For instance, if a poor reader has a specific fear of reading, then clinicians should consider teaching children strategies to lower their anxiety before engaging in reading training. This approach will equip poor readers with strategies to face their fear of reading in a gradual way, and lower their arousal before learning new reading skills. We are currently using this rationale to develop a combined reading and anxiety intervention for anxious poor readers.

Limitations of the current literature

The studies included in this review have a number of limitations in common. As previously mentioned, poor reading is a heterogeneous disorder that comprises various reading problems that differ in nature and severity, and there are no gold standard criteria to define different types of poor reading. In line with this, the studies included in this review varied in their sample selection and definition of poor reading, and most studies selected poor readers based on performance on general measures of reading that assessed both regular and irregular words. Given this variability between studies, it would be helpful if future research conducted more detailed reading assessments with poor readers. This would allow us to

examine the possible moderating role of poor reading subtypes on the association between poor reading and anxiety.

There were also very few studies included in this review that reported the full characteristics of their sample. For instance, only 14 of the 22 anxiety studies reported their participants' ethnicity. In future research, recruiting samples of different ethnicities would allow for more direct examination of the possible moderating role of ethnicity. The included studies also underrepresented female poor readers, with only two studies including more female than male participants. Again, including samples with predominantly female participants would allow for more direct comparison of the possible moderating role of sex on this association. Finally, our quality appraisal revealed that majority of the studies included in the review did not include representative or justified samples. Thus, future research is needed on the association between poor reading and anxiety to evaluate the strength of this association in representative samples.

A third limitation of the studies in this review is that most used dimensional questionnaires to measure anxiety symptoms. Such measures do not provide information about anxiety disorders, which can only be diagnosed using categorical clinical interviews. Two studies that used clinical interviews discovered that poor readers have separation anxiety (Carroll et al., 2005) or generalised anxiety (Carroll et al., 2005; Willcutt et al., 2013), while the third study found no difference in generalised anxiety between poor readers and controls (Wu, 2018a). We need more studies using clinical interviews to ascertain if poor readers are at higher risk for these anxiety disorders.

Limitations of the current review

The main limitation of this review is the modest number of included studies (i.e., 34). Given the importance of understanding the emotional health of poor readers for their quality of life, this highlights the need for more studies on internalising problems in poor readers.

A second limitation – again stemming from a limited literature – is that we were unable to conduct the planned subgroup analyses. As Tables S2 and S3 show, even if a more conservative criterion was applied (i.e., five studies per subgroup), there would have been insufficient numbers for the subgroup analyses. This highlights the need for future studies to examine potential moderating variables on the association between poor reading and internalising problems – and particularly anxiety.

This review also focussed on the association, or “correlation”, between poor reading and internalising problems. While correlational studies are a sensible starting point for understanding the relationship between two variables, they cannot inform us about the direction of causation between those two variables. For example, in the context of this review, such studies cannot reveal if poor reading causes internalising problems, if the reverse is true, if there is a bidirectional relationship between poor reading and internalising problems, or if another factor has a causal effect on both reading and internalising that creates a “faux” association between the two. Given that the evidence to date supports a statistically reliable association between poor reading and internalising problems – particularly for anxiety – intervention studies are needed to test the causal mechanisms that might be responsible for this association. Such studies are extremely rare at this point in time (Grills et al., 2014).

Conclusions

This is the first systematic meta-analytic review of the association between poor reading and internalising problems, poor reading and anxiety, and poor reading and depression. The meta-analysis suggests that there is a statistically reliable association between poor reading and internalising problems, and between poor reading and anxiety. The

association between poor reading and depression is also statistically reliable, yet smaller in size and less stable. When considered together, the effect sizes suggest that the association between poor reading and internalising problems is driven by, or most closely reflects, an association between poor reading and anxiety – rather than an association between poor reading and depression. The outcomes from this review guide clinicians to make informed decisions about how to assess poor readers for problems with anxiety, and suggests that we now need to investigate *why* this association exists.

REFERENCES

References marked with an asterisk indicate studies included in the meta-analysis

- Achenbach, T. M. (1966). The classification of children's psychiatric symptoms: A factor-analytic study. *Psychological Monographs: General and Applied*, 80, 1-37. doi: 10.1037/h0093906
- Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Achenbach, T. M., & Edelbrock, C. S. (1978). The classification of child psychopathology: A review and analysis of empirical efforts. *Psychological Bulletin*, 85, 1275-1301. doi: 10.1037/0033-2909.85.6.1275
- *Aman, M. G. (1979). Cognitive, social, and other correlates of specific reading retardation. *Journal of Abnormal Child Psychology*, 7, 153-168. doi: 10.1007/BF00918896
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.
- Anderson, E. R., & Mayes, L. C. (2010). Race/ethnicity and internalizing disorders in youth: A review. *Clinical Psychology Review*, 30, 338-348. doi: 10.1016/j.cpr.2009.12.008
- *Arnold, E. M., Goldston, D. B., Walsh, A. K., Reboussin, B. A., Daniel, S. S., Hickman, E., & Wood, F. B. (2005). Severity of emotional and behavioural problems among poor and typical readers. *Journal of Abnormal Child Psychology*, 33, 205-217. doi: 10.1007/s10802-005-1828-9
- Barbosa, J., Tannock, R., & Manassis, K. (2002). Measuring anxiety: Parent-child reporting differences in clinical samples. *Depression and Anxiety*, 15, 61-65. doi: 10.1002/da.10022
- Barriga, A. Q., Doran, J. W., Newell, S. B., Morrison, E. M., Barbetti, V., & Robbins, B. D. (2002). Relationships between problem behaviours and academic achievement in

- adolescents: The unique role of attention problems. *Journal of Emotional and Behavioural Disorders*, 10, 233-240. doi: 10.1177/10634266020100040501
- Baxter, A. J., Scott, K. M., Vos, T., & Whiteford, H. A. (2012). Global prevalence of anxiety disorders: A systematic review and meta-regression. *Psychological Medicine*, 43, 897-912. doi: 10.1017/S003329171200147X
- *Boetsch, E. A. (1997). *A longitudinal study of the relationship between dyslexia and socioemotional functioning in young children*. (Unpublished doctoral dissertation). University of Denver, United States.
- *Boetsch, E. A., Green, P. A., & Pennington, B. F. (1996). Psychosocial correlates of dyslexia across the lifespan. *Development and Psychopathology*, 8, 539-562. doi: 10.1017/S0954579400007264
- Beidel, D. C. (1988). Psychophysiological assessment of anxious emotional states in children. *Journal of Abnormal Psychology*, 97, 80-82. doi: 10.1037/0021-843X.97.1.80
- Beidel, D. C. & Turner, S. M. (1988). Comorbidity of test anxiety and other anxiety disorders in children. *Journal of Abnormal Child Psychology*, 16, 275-287. doi: 10.1007/BF00913800
- Bogels, S. M., Alden, L., Beidel, D. C., Clark, L. A., Pine, D. S., Stein, M. B., & Voncken, M. (2010). Social anxiety disorder: Questions and answers for the DSM-V. *Depression and Anxiety*, 27, 168-189. doi: 10.1002/da.20670
- Bonifacci, P., Montuschi, M., Lami, L., & Snowling, M. J. (2014). Parents of children with dyslexia: Cognitive, emotional and behavioural profile. *Dyslexia*, 20, 175-190. doi: 10.1002/dys.1469
- Borenstein, M., Hedges, L.V., Higgins, J.P.T., & Rothstein, H.R. (2006). *Comprehensive Meta-analysis*. Englewood, NJ: Biostat

- Bruce, S. E. et al. (2005). Influence of psychiatric comorbidity on recovery and recurrence in generalized anxiety disorder, social phobia, and panic disorder: A 12-year prospective study. *American Journal of Psychiatry*, 162, 1179-1187. doi: 10.1176/appi.ajp.162.6.1179
- *Carroll, J. M., & Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology*, 76, 651-662. doi: 10.1348/000709905X66233
- *Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, 46, 524-532. doi: 10.1111/j.1469-7610.2004.00366.x
- Castles, A., & Coltheart, M. (1993). Varieties of developmental dyslexia. *Cognition*, 47, 149-180. doi: 10.1016/0010-0277(93)90003-E
- *Chapman, J. W., Tunmer, W. E., & Prochnow, J. E. (2004). Repressed resilience? A longitudinal study of reading, self-perceptions and teacher behaviour ratings of poor and average readers in New Zealand. *Journal of the International Academy for Research in Learning Disabilities*, 22, 9-15. Retrieved from www.iarld.com/the-journal-thalamus
- Cohen J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). New Jersey: Lawrence Erlbaum Associates.
- *Davis, K., Margolis, A. E., Thomas, L., Huo, A., & Marsh, R. (2017). Amygdala sub-regional functional connectivity predicts anxiety in children with reading disorder. *Developmental Science*, 21, e12631. doi: 10.1111/desc.12631
- *Daniel, S. S., Walsh, A. K., Goldston, D. B., Arnold, E. M., Reboussin, B. A., & Wood, F. B. (2006). Suicidality, school dropout and reading problems among adolescents. *Journal of Learning Disabilities*, 39, 507-514. doi: 10.1177/00222194060390060301

- Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, 56, 455-463. doi: 10.1111/j.0006-341X.2000.00455.x
- Egger, M., Davey Smith, G., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, 315, 629–634. doi: 10.1136/bmj.315.7109.629
- Ford, T., Goodman, R., & Meltzer, H. (2003). The British child and adolescent mental health survey 1999: The prevalence of DSM-IV disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, 42, 1203-1211. doi: 10.1097/00004583-200310000-00011
- Ginsburg, G. S., & Silverman, W. K. (1996). Phobic and anxiety disorders in Hispanic and Caucasian youth. *Journal of Anxiety Disorders*, 10, 517-528. doi: 10.1016/S0887-6185(96)00027-8
- Goldston, D. B. et al. (2007). Reading problems, psychiatric disorders, and functional impairment from mid- to late adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry*, 46, 25-33. doi: 10.1097/01.chi.0000242241.77302.f4
- Goulandris, N. K., & Snowling, M. (1991). Visual memory deficits: A plausible cause of developmental dyslexia? Evidence from a single case study. *Cognitive Neuropsychology*, 8, 127-154. doi: 10.1080/02643299108253369
- *Grills, A. E., Fletcher, J. M., Vaughn, S., Barth, A., Denton, C. A., & Stuebing, K. K. (2014). Anxiety and response to reading intervention among first grade students. *Child Youth Care Forum*, 43, 417-431. doi: 10.1007/s10566-014-9244-3
- Grills, A. E., Fletcher, J. M., Vaughn, S. R., Denton, C. A., & Taylor, P. (2013). Anxiety and inattention as predictors of achievement in early elementary school children. *Anxiety, Stress, & Coping*, 26, 391-410. doi: 10.1080/10615806.2012.691969

- Grills, A. E., & Ollendick, T. H. (2002). Issues in parent-child agreement: The case of structured diagnostic interviews. *Clinical Child and Family Psychology Review*, 5, 57-83. doi: 10.1023/A:10145737
- Hedges, L.V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Orlando, FL: Academic Press.
- Higgins, J. P. T. & Green S. (2008). *Cochrane Handbook for Systematic Reviews of Interventions*. Chichester, UK: John Wiley & Sons, Ltd.
- Higgins, J., Thompson, S.G., Deeks, J.J., & Altman, D.G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, 327, 557–560. doi: 10.1136/bmj.327.7414.557
- *Hoy, C., Gregg, N., Wisenbaker, J., Manglitz, E., King, M., & Moreland, C. (1997). Depression and anxiety in two groups of adults with learning disabilities. *Learning Disability Quarterly*, 20, 280-291. doi: 10.2307/1511226
- *Hughes, J. A., Phillips, G., & Reed, P. (2013). Brief exposure to a self-paced computer based reading programme and how it impacts reading ability and behaviour problems. *PLoS ONE*, 8, e77867. doi: 10.1371/journal.pone.0077867
- Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry*, 62, 617-629. doi: 10.1001/archpsyc.62.6.617
- Kovacs, M. (1992). *Children's Depression Inventory*. North Tonawanda, NY: Multi-Health System.
- Krueger, R. F., & Eaton, N. R. (2015). Transdiagnostic factors of mental disorders. *World Psychiatry*, 14, 27-29. doi: 10.1002/wps.20175

- Levy, F., Hay, D. A., Bennett, K. S., & McStephen, M. (2005). Gender differences in ADHD subtype comorbidity. *Journal of the American Academy of Child & Adolescent Psychiatry*, 44, 368-376. doi: 10.1097/01.chi.0000153232.64968.c1
- Lewinsohn, P., Gotlib, I., Lewinsohn, M., Seeley, J. R., & Allen, N. B. (1998). Gender differences in anxiety disorders and anxiety symptoms in adolescents. *Journal of Abnormal Psychology*, 107, 109-117. doi: 10.1037//0021-843X.107.1.109
- Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage Publications.
- *MacPhail, S. S. (2013). *Perceived competence and depressive symptoms in children with reading problems*. (Unpublished doctoral thesis). Fordham University, New York.
- March, J. (1997). *Multidimensional Anxiety Scale for Children*. North Tonawanda, NY: Multi-Health Systems.
- *Martinez, R. S., & Semrud-Clikeman, M. (2004). Emotional adjustment and school functioning of young adolescents with multiple versus single learning disabilities. *Journal of Learning Disabilities*, 37, 411-420. doi: 10.1177/00222194040370050401
- Maughan, B., & Carroll, J. (2006). Literacy and mental disorders. *Current Opinion in Psychiatry*, 19, 350-354. doi: 10.1097/01.yco.0000228752.79990.41
- *Maughan, B., Rowe, R., Loeber, R., & Stouthamer-Loeber, M. (2003). Reading problems and depressed mood. *Journal of Abnormal Child Psychology*, 31, 219-229. doi: 10.1023/A:1022534527021
- McArthur, G., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., Banales, E., & Castles, A. (2013). Getting to grips with the heterogeneity of developmental dyslexia. *Cognitive Neuropsychology*, 30, 1-24. doi: 10.1080/02643294.2013.784192
- *McGee, R., Williams, S., Share, D. L., Anderson, J., & Silva, P. A. (1986). The relationship between specific reading retardation, general reading backwardness and behavioural

problems in a large sample of Dunedin boys: A longitudinal study from five to eleven years. *Journal of Child Psychology and Psychiatry*, 27, 597-610. doi: 10.1111/j.1469-7610.1986.tb00185.x

McLean, C. P., Asnaani, A., Litz, B. T., & Hofmann, S. G. (2011). Gender differences in anxiety disorders: Prevalence, course of illness, comorbidity and burden of illness. *Journal of Psychiatric Research*, 45, 1027-1035. doi: 10.1016/j.jpsychires.2011.03.006

*Mercer, K. L. (2005). *Relations of self-efficacy to symptoms of depression and anxiety in adolescents with learning disabilities*. (Unpublished doctoral thesis). The University of British Columbia, United States.

Micheline, G., Eley, T. C., Gregory, A. M., & McAdams, T. A. (2015). Aetiological overlap between anxiety and attention deficit hyperactivity symptom dimensions in adolescence. *Journal of Child Psychology and Psychiatry*, 56, 423-431. doi: 10.1111/jcpp.12318

*Miller, C. J., Hynd, G. W., & Miller, S. R. (2005). Children with dyslexia: Not necessarily at risk for elevated internalising symptoms. *Reading & Writing*, 18, 425-436. doi: 10.1007/s11145-005-4314-4

Mugnaini, D., Lassi, S., La Malfa, G., & Albertini, G. (2009). Internalising correlates of dyslexia. *World Journal of Pediatrics*, 5, 255-264. doi: 10.1007/s12519-009-0049-7

*Murray, M. E. (1978). The relationship between personality adjustment and success in remedial programs in dyslexic children. *Contemporary Educational Psychology*, 3, 330-339. doi: 10.1016/0361-476X(78)90035-8

Nation, K., Cocksey, J., Taylor, J. S. H., & Bishop, V. M. (2010). A longitudinal investigation of early reading and language skills in children with poor reading comprehension. *The Journal of Child Psychology and Psychiatry*, 51, 1031-1039. doi:

10.1111/j.1469-7610.2010.02254.x

*Nelson, J. M., & Gregg, N. (2012). Depression and anxiety among transitioning adolescents and college students with ADHD, dyslexia or comorbid ADHD/dyslexia. *Journal of Attention Disorders*, 16, 244-254. doi: 10.1177/1087054710385783

Nelson, J. M., & Harwood, H. R., (2011a). A meta-analysis of parent and teacher reports of depression among students with learning disabilities: Evidence for the importance of multi-informant assessment. *Psychology in the Schools*, 48, 371-385. doi: 10.1002/pits.20560

Nelson, J. M., & Harwood, H. (2011b). Learning disabilities and anxiety: A meta-analysis. *Journal of Learning Disabilities*, 44, 3-17. doi: 10.1177/0022219409359939

*Nelson, J. M., & Liebel, S. W. (2017). Socially desirable responding and college students with dyslexia: Implications for the assessment of anxiety and depression. *Dyslexia*, 24, 44-58. doi: 10.1002/dys.1563

*Nelson, J. M., Lindstrom, W., & Foels, P. A. (2015). Test anxiety among college students with specific reading disability (Dyslexia): Nonverbal ability and working memory as predictors. *Journal of Learning Disabilities*, 48, 422-432. doi: 10.1177/0022219413507604

Oakhill, J. V., Cain, K., & Bryant, P. E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes*, 18, 443-468. doi: 10.1080/01690960344000008

Patel, T. K., Snowling, M. J., & de Jong, P. F. (2004). A cross-linguistic comparison of children learning to read in English and Dutch. *Journal of Educational Psychology*, 96, 785-797. doi: 10.1037/0022-0663.96.4.785

*Pierce, M. E., Wechsler-Zimring, A., Noam, G., Wolf, M., & Katzir, T. (2013). Behavioural problems and reading difficulties among language minority and monolingual urban

elementary school students. *Reading Psychology*, 34, 182-205. doi:

10.1080/02702711.2011.626108

*Plaisance, R. L. (1994). *Psychiatric comorbidity in children with disabilities*. (Unpublished doctoral thesis). Athens Georgia, United States.

Power, T. J., Costigan, T. E., Eiraldi, R. B., & Leff, S. S. (2004). Variations in anxiety and depression as a function of ADHD subtypes defined by DSM-IV: Do subtype differences exist or not? *Journal of Abnormal Child Psychology*, 32, 27-37. doi:

10.1023/B:JACP.00000007578.30863.93

Safford, S. M., Kendall, P. C., Flannery-Schroeder, E., Webb, A., & Sommer, H. (2005). A longitudinal look at parent-child diagnostic agreement in youth treated for anxiety disorders. *Journal of Clinical Child & Adolescent Psychology*, 34, 747-757. doi:

10.1207/s15374424jccp3404_16

*Sanson, A., Prior, M., & Smart, D. (1996). Reading disabilities with and without behaviour problems at 7-8 years: Prediction from longitudinal data from infancy to 6 years.

Journal of Child Psychology and Psychiatry, 37, 529-541. doi: 10.1111/j.1469-7610.1996.tb01439.x

*Scarborough, H. S., & Parker, J. D. (2003). Matthew effects in children with learning disabilities: Development of reading, IQ, and psychosocial problems from grade 2 to grade 8. *Annals of Dyslexia*, 53, 47-71. doi: 10.1007/s11881-003-0004-6

Shamseer, L., et al. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: Elaboration and explanation. *BMJ*, 349, g7647. doi:

10.1136/bmj.g7647

Shaywitz, B. A., et al. (1995). A Matthew effect for IQ but not for reading: Results from a longitudinal study. *Reading Research Quarterly*, 30, 894-906. doi: 10.2307/748203

- Silverman, W. K., & Albano, A. M. (1996). *Manual for the ADIS-IV-C/P*. New York, NY: Psychological Corporation.
- Snowling, M., Dawes, P., Nash, H., & Hulme, C. (2012). Validity of a protocol for adult self-report of dyslexia and related difficulties. *Dyslexia, 18*, 1-15. doi: 10.1002/dys.1432
- *Snowling, M. J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A follow-up in early adolescence. *Journal of Child Psychology and Psychiatry, 48*, 609-618. doi: 10.1111/j.1469-7610.2006.01725.x
- Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour Research and Therapy, 36*, 545-566. doi: 10.1016/S0005-7967(98)00034-5
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Stuart, M., & Stainthorp, R. (2016). *Reading development and teaching*. London: SAGE.
- *Tomblin, J. B., Zhang, X., Buckwalter, P., & Catts, H. (2000). The association of reading disability, behavioural disorders, and language impairment among second-grade children. *Journal of Child Psychology and Psychiatry, 41*, 473-482. doi: 10.1111/1469-7610.00632
- Umana-Taylor, A. J., & Updegraff, K. A. (2007). Latino adolescents' mental health: Exploring the interrelations among discrimination, ethnic identity, cultural orientation, self-esteem, and depressive symptoms. *Journal of Adolescence, 30*, 549-567. doi: 10.1016/j.adolescence.2006.08.002
- Wells, G. A., et al. (1996). The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Available at http://www.ohri.ca/programs/clinical_epidemiology/oxfordasp. Accessed September 2, 2016.
- *Willcutt, E. G., Petrill, S. A., Wu, S., Boada, R., DeFries, J. C., Olson, R. K. et al. (2013). Comorbidity between reading disability and math disability: Concurrent

psychopathology, functional impairment, and neuropsychological functioning.

Journal of Learning Disabilities, 46, 500-516. doi: 10.1177/0022219413477476

*Wu, S. S. (2018). *Measurement and classification issues in mathematics and reading disorders*. (Unpublished doctoral thesis). The University of Colorado, Boulder.

APPENDIX A

Search terms used to conduct the search

1. dyslexia
2. reading disorder
3. reading impairment
4. reading deficit
5. reading delay
6. reading dysfunction
7. reading achievement
8. reading difficulty
9. reading problem
10. poor reading
11. poor literacy
12. specific learning disorder
13. anxiety
14. depression
15. psychosocial
16. internalising
17. psychological comorbidity
18. suicide

APPENDIX B

Studies included in the Systematic Review and Meta-Analysis

- Aman, M. G. (1979). Cognitive, social, and other correlates of specific reading retardation. *Journal of Abnormal Child Psychology*, 7, 153-168. doi: 10.1007/BF00918896
- Arnold, E. M., Goldston, D. B., Walsh, A. K., Reboussin, B. A., Daniel, S. S., Hickman, E., & Wood, F. B. (2005). Severity of emotional and behavioural problems among poor and typical readers. *Journal of Abnormal Child Psychology*, 33, 205-217. doi: 10.1007/s10802-005-1828-9
- Boetsch, E. A. (1997). *A longitudinal study of the relationship between dyslexia and socioemotional functioning in young children*. (Unpublished doctoral dissertation). University of Denver, United States.
- Boetsch, E. A., Green, P. A., & Pennington, B. F. (1996). Psychosocial correlates of dyslexia across the lifespan. *Development and Psychopathology*, 8, 539-562. doi: 10.1017/S0954579400007264
- Carroll, J. M., & Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology*, 76, 651-662. doi: 10.1348/000709905X66233
- Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, 46, 524-532. doi: 10.1111/j.1469-7610.2004.00366.x
- Chapman, J. W., Tunmer, W. E., & Prochnow, J. E. (2004). Repressed resilience? A longitudinal study of reading, self-perceptions and teacher behaviour ratings of poor and average readers in New Zealand. *Journal of the International Academy for Research in Learning Disabilities*, 22, 9-15. Retrieved from www.iarld.com/the-journal-thalamus

- Daniel, S. S., Walsh, A. K., Goldston, D. B., Arnold, E. M., Reboussin, B. A., & Wood, F. B. (2006). Suicidality, school dropout and reading problems among adolescents. *Journal of Learning Disabilities, 39*, 507-514. doi: 10.1177/00222194060390060301
- Davis, K., Margolis, A. E., Thomas, L., Huo, A., & Marsh, R. (2017). Amygdala sub-regional functional connectivity predicts anxiety in children with reading disorder. *Developmental Science*, e12631. doi: 10.1111/desc.12631
- Grills, A. E., Fletcher, J. M., Vaughn, S., Barth, A., Denton, C. A., & Stuebing, K. K. (2014). Anxiety and response to reading intervention among first grade students. *Child Youth Care Forum, 43*, 417-431. doi: 10.1007/s10566-014-9244-3
- Hoy, C., Gregg, N., Wisenbaker, J., Manglitz, E., King, M., & Moreland, C. (1997). Depression and anxiety in two groups of adults with learning disabilities. *Learning Disability Quarterly, 20*, 280-291. doi: 10.2307/1511226
- Hughes, J. A., Phillips, G., & Reed, P. (2013). Brief exposure to a self-paced computer based reading programme and how it impacts reading ability and behaviour problems. *PLoS ONE, 8*, e77867. doi: 10.1371/journal.pone.0077867
- MacPhail, S. S. (2013). *Perceived competence and depressive symptoms in children with reading problems*. (Unpublished doctoral thesis). Fordham University, New York.
- Martinez, R. S., & Semrud-Clikeman, M. (2004). Emotional adjustment and school functioning of young adolescents with multiple versus single learning disabilities. *Journal of Learning Disabilities, 37*, 411-420. doi: 10.1177/00222194040370050401
- Maughan, B., Rowe, R., Loeber, R., & Stouthamer-Loeber, M. (2003). Reading problems and depressed mood. *Journal of Abnormal Child Psychology, 31*, 219-229. doi: 10.1023/A:1022534527021
- McGee, R., Williams, S., Share, D. L., Anderson, J., & Silva, P. A. (1986). The relationship between specific reading retardation, general reading backwardness and behavioural

- problems in a large sample of Dunedin boys: A longitudinal study from five to eleven years. *Journal of Child Psychology and Psychiatry*, 27, 597-610. doi: 10.1111/j.1469-7610.1986.tb00185.x
- Mercer, K. L. (2005). *Relations of self-efficacy to symptoms of depression and anxiety in adolescents with learning disabilities*. (Unpublished doctoral thesis). The University of British Columbia, United States.
- Miller, C. J., Hynd, G. W., & Miller, S. R. (2005). Children with dyslexia: Not necessarily at risk for elevated internalising symptoms. *Reading & Writing*, 18, 425-436. doi: 10.1007/s11145-005-4314-4
- Murray, M. E. (1978). The relationship between personality adjustment and success in remedial programs in dyslexic children. *Contemporary Educational Psychology*, 3, 330-339. doi: 10.1016/0361-476X(78)90035-8
- Nelson, J. M., & Gregg, N. (2012). Depression and anxiety among transitioning adolescents and college students with ADHD, dyslexia or comorbid ADHD/dyslexia. *Journal of Attention Disorders*, 16, 244-254. doi: 10.1177/1087054710385783
- Nelson, J. M., & Liebel, S. W. (2017). Socially desirable responding and college students with dyslexia: Implications for the assessment of anxiety and depression. *Dyslexia*, 24, 44-58. doi: 10.1002/dys.1563
- Nelson, J. M., Lindstrom, W., & Foels, P. A. (2015). Test anxiety among college students with specific reading disability (Dyslexia): Nonverbal ability and working memory as predictors. *Journal of Learning Disabilities*, 48, 422-432. doi: 10.1177/0022219413507604
- Pierce, M. E., Wechsler-Zimring, A., Noam, G., Wolf, M., & Katzir, T. (2013). Behavioural problems and reading difficulties among language minority and monolingual urban elementary school students. *Reading Psychology*, 34, 182-205. doi:

10.1080/02702711.2011.626108

Plaisance, R. L. (1994). *Psychiatric comorbidity in children with disabilities*. (Unpublished doctoral thesis). Athens Georgia, United States.

Sanson, A., Prior, M., & Smart, D. (1996). Reading disabilities with and without behaviour problems at 7-8 years: Prediction from longitudinal data from infancy to 6 years. *Journal of Child Psychology and Psychiatry*, 37, 529-541. doi: 10.1111/j.1469-7610.1996.tb01439.x

Scarborough, H. S., & Parker, J. D. (2003). Matthew effects in children with learning disabilities: Development of reading, IQ, and psychosocial problems from grade 2 to grade 8. *Annals of Dyslexia*, 53, 47-71. doi: 10.1007/s11881-003-0004-6

Snowling, M. J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A follow-up in early adolescence. *Journal of Child Psychology and Psychiatry*, 48, 609-618. doi: 10.1111/j.1469-7610.2006.01725.x

Tomblin, J. B., Zhang, X., Buckwalter, P., & Catts, H. (2000). The association of reading disability, behavioural disorders, and language impairment among second-grade children. *Journal of Child Psychology and Psychiatry*, 41, 473-482. doi: 10.1111/1469-7610.00632

Willcutt, E. G. et al. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities*, 46, 500-516. doi: 10.1177/0022219413477476

Wu, S. S. (2018). *Measurement and classification issues in mathematics and reading disorders*. (Unpublished doctoral thesis). The University of Colorado, Boulder.

APPENDIX C

Characteristics of Studies Included in the Meta-Analysis

Table C1

Methods, participants, outcomes, and notes from Aman (1979)

Methods	Group comparison study Country: New Zealand
Participants	Reading criteria: a score that showed a minimum deficit of 24 months on at least two of three reading tests (Schonell Test R1, Neale Analysis of Reading Ability: reading accuracy and reading comprehension) Recruits: 28 English-speaking children (ranging from 91 months to 146 months) Controls: 28 English-speaking children (ranging from 97 months to 145 months) Poor reading group: $n = 28$ Control group: $n = 28$
Outcomes	Anxiety: anxiety/tension (Conner's Teacher Questionnaire)
Notes	Nil

Table C2
Methods, participants, outcomes, and notes from Arnold (2005)

Methods	<p>Longitudinal study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: a raw score at or below 44 (equivalent to the 18th percentile for age 16 norms) on subtests from the Woodcock-Johnson Psychoeducational Battery-Revised</p> <p>Recruits: 94 English-speaking children (aged 15 years at baseline)</p> <p>Controls: 94 English-speaking children (aged 15 years at baseline)</p> <p>Poor reading group: $n = 94$</p> <p>Control group: $n = 94$</p>
Outcomes	<p>Anxiety: somatic complaints (Child Behaviour Checklist), somatic complaints (Youth Self-Report), trait anxiety (State Trait Anxiety Inventory)</p> <p>Depression: depression (Beck Depression Inventory)</p> <p>Internalising: internalising (Child Behaviour Checklist)</p>
Notes	<p>Data was extracted from baseline</p> <p>The two measures of somatic complaints were combined</p>

Table C3
Methods, participants, outcomes, and notes from Boetsch (1996a)

Methods	<p>Group comparison study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Age discrepancy definition where there was a significant difference between observed reading and spelling levels and the levels that would be expected based on age and educational experience. This was measured using a discriminant function score (< 0) based on performance on tests of visual word recognition and reading comprehension (Peabody Individual Achievement Test)</p> <p>Recruits: 18 English-speaking adults (ranging from 30 years to 55 years)</p> <p>Controls: 18 English-speaking adults (ranging from 30 years to 55 years)</p> <p>Poor reading group: $n = 18$</p> <p>Control group: $n = 18$</p>
Outcomes	<p>Depression: depression (the Centre for Epidemiologic Studies Depression Scale)</p> <p>Internalising: emotional distress (the Brief Symptom Inventory)</p>
Notes	<p>Data from the subscales of Adaptation (for adults) of the Dimension of Depression Profile for Children and Adolescents test was requested but unavailable. There was no response from the author.</p>

Table C4
Methods, participants, outcomes, and notes from Boetsch (1996b)

Methods	<p>Group comparison study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Age discrepancy definition where children and adolescents showed a significant discrepancy between their observed reading and spelling levels and the levels that would be expected based on age and educational experience. An IQ discrepancy criterion with a cut off of .82 was used.</p> <p>Recruits: 70 English-speaking children and adolescents (ranging from 7 to 18 years)</p> <p>Controls: 67 English-speaking children and adolescents (range not reported, but $M = 11.62$ years, $SD = 2.94$ years)</p> <p>Poor reading group: $n = 70$</p> <p>Control group: $n = 67$</p>
Outcomes	<p>Depression: suicide, self-blame, energy, and depressed mood subscales (Dimensions of Depression Profile for Children and Adolescents)</p>
Notes	<p>Language not reported, but English as a first language was presumed given the country and tests administered</p>

Table C5
Methods, participants, outcomes, and notes from Boetsch (1996c)

Methods	<p>Group comparison study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Age discrepancy definition where there was a significant difference between observed reading and spelling levels and the levels that would be expected based on age and educational experience. This was measured using a discriminant function score (< 0) based on performance on tests of visual word recognition and reading comprehension (Peabody Individual Achievement Test)</p> <p>Recruits: 26 English-speaking children and adolescents (ranging from 7 to 18 years)</p> <p>Controls: 26 English-speaking children and adolescents (range not reported, but $M = 10.4$, $SD = 1.59$)</p> <p>Poor reading group: $n = 26$</p> <p>Control group: $n = 26$</p>
Outcomes	<p>Depression: suicide, self-blame, energy and depressed mood (Dimensions of Depression Profile for Children and Adolescents), depression symptoms (Childhood Depression Inventory)</p>
Notes	<p>Data from the Diagnostic Interview for Children and Adolescents, Child Behaviour Checklist, and Youth Self Report measures were requested but unavailable</p>

Table C6
Methods, participants, outcomes, and notes from Boetsch (1996d)

Methods	<p>Group comparison study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Age discrepancy definition where there was a significant difference between observed reading and spelling levels and the levels that would be expected based on age and educational experience. This was measured using a discriminant function score (< 0) based on performance on tests of visual word recognition and reading comprehension (Peabody Individual Achievement Test)</p> <p>Recruits: 98 English-speaking children (ranging from 8 to 18 years)</p> <p>Controls: 118 English-speaking children (range not reported, but $M = 11.25$ years, $SD = 2.24$ years)</p> <p>Poor reading group: $n = 98$</p> <p>Control group: $n = 118$</p>
Outcomes	<p>Depression: suicide, self-blame, energy, depressed mood (Dimensions of Depression Profile for Children and Adolescents)</p> <p>Internalising: internalising (Youth Self-Report)</p>
Notes	<p>Data from the depression subscale of the Child Behaviour Checklist, Diagnostic Interview for Children and Adolescents and Youth Self-Report were requested but unavailable</p> <p>Anxiety was measured using the Diagnostic Interview for Children and Adolescents. Data was requested but unavailable.</p>

Table C7
Methods, participants, outcomes, and notes from Boetsch (1997)

Methods	<p>Longitudinal study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: (1) reading quotient < .08, which equates to approximately one standard deviation below typical readers, and (2) regression based IQ discrepancy score, where the observed score was compared to a predicted reading score based on observed IQ score</p> <p>Recruits: 28 English-speaking children (range not reported, $M = 5.34$ years, $SD = 0.40$ years at Year 1)</p> <p>Controls: 38 English-speaking children (range not reported, $M = 5.31$ years, $SD = 0.32$ years at Year 1)</p> <p>Poor reading group: $n = 28$</p> <p>Control group: $n = 38$</p>
Outcomes	<p>Depression: mood composite (Child Depression Inventory)</p>
Notes	<p>“Low risk” poor readers were recruited into this study but excluded because the group was “too small to study”</p> <p>Data extracted from Year 1</p>

Table C8
Methods, participants, outcomes, and notes from Carroll (2005)

Methods	<p>Cross-sectional analysis of longitudinal study</p> <p>Country: United Kingdom</p>
Participants	<p>Reading criteria: A regression equation was calculated to predict children's reading and spelling scores on the basis of their vocabulary scores. The 5% of children with reading or spelling scores furthest below their predicted scores were classified as showing specific literacy difficulties</p> <p>Recruits: 289 English-speaking children and adolescents (ranging from 9 to 15 years)</p> <p>Controls: 5,463 English speaking children and adolescents (range, <i>M</i> and <i>SD</i> not reported)</p> <p>Poor reading group: <i>n</i> = 289</p> <p>Control group: <i>n</i> = 5,463</p>
Outcomes	<p>Anxiety: anxiety, generalised anxiety disorder, separation anxiety disorder, specific phobias and anxiety not otherwise specified, (Development and Well Being Assessment)</p> <p>Depression: depression (Development and Well Being Assessment), depression (Short Mood and Feelings Questionnaire)</p> <p>Internalising: emotional problems (Strengths and Difficulties Questionnaire), emotional problems (Strengths and Difficulties Questionnaire)</p>
Notes	<p>Language not reported, but English presumed given the country and tests administered. Anxiety disorders < 5% prevalence rate not analysed.</p>

Table C9
Methods, participants, outcomes, and notes from Carroll (2006)

Methods	Cross-sectional analysis of longitudinal study Country: United Kingdom
Participants	Reading criteria: Dyslexic participants had previous recognised assessments. Reading scores St. Sc ($M = 87$, $SD = 9.87$) on tests of reading fluency (TOWRE) in addition to scores being significantly below a typical reading control group Recruits: 16 English-speaking adults (range 19.4 to 24.0 years, $M = 21.5$ years, SD not reported) Controls: 16 English-speaking adults (range 19.2 to 22.5 years, $M = 21.6$ years, SD not reported) Poor reading group: $n = 16$ Control group: $n = 16$
Outcomes	Anxiety: academic anxiety, social anxiety, appearance anxiety (trait anxiety experimental questionnaire), state anxiety (State-Trait Anxiety Inventory)
Notes	Nil

Table C10
Methods, participants, outcomes, and notes from Chapman (2004)

Methods	<p>Longitudinal study</p> <p>Country: New Zealand</p>
Participants	<p>Reading criteria: Scores on the Interactive Reading Assessment System Listening Comprehension subtest above the 40th percentile and reading comprehension scores on the Interactive Reading Assessment System below the 30th percentile*</p> <p>Recruits: 19 English-speaking children (range not reported, but overall sample age at T1 reported, $M = 5$ years, 1 month)</p> <p>Controls: 55 English-speaking children (range not reported, but overall sample age at T1 reported, $M = 5$ years, 1 month)</p> <p>Poor reading group: $n = 19$</p> <p>Control group: $n = 55$</p>
Outcomes	<p>Anxiety: somatic complaints (Child Behaviour Checklist)</p> <p>Internalising: Social problems, anxious/depressed (Child Behaviour Checklist)</p> <p>Depression: withdrawn (Child Behaviour Checklist)</p>
Notes	<p>A second group of non-dyslexic poor readers were also included in this study, but data not extracted as reading test data showed that this group did not have a reading difficulty in accord with our criteria</p> <p>*Poor readers performed significantly below control participants on measures of phonological recoding and visual word recognition</p> <p>Data was extracted from Year 3 - the earliest time point where poor reading and internalising, anxiety, or depression were measured together</p>

Table C11

Methods, participants, outcomes, and notes from Daniel (2006)

Methods	Longitudinal study Country: United States
Participants	Reading criteria: Raw score below 45 (equivalent to the 18 th percentile) on the Letter Word Identification Subtest (Woodcock Johnson Psychoeducational Battery-Revised) Recruits: 94 English-speaking adolescents (ranging from 15.0 to 15.8 years at screening) Controls: 94 English-speaking adolescents (ranging from 15.0 to 15.9 years at screening) Poor reading group: $n = 94$ Control group: $n = 94$
Outcomes	Depression: major depression, suicidal behaviours (Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Epidemiologic Version)
Notes	Nil

Table C12

Methods, participants, outcomes, and notes from Davis (2017)

Methods	Cross-sectional Country: United States
Participants	Reading criteria: Clinical history of reading difficulties and initial screening at or below 25 th percentile. Inspection of performance on tests of reading rate, accuracy, and fluency (GORT-5) confirmed poor reading status Recruits: 22 English-speaking children ($M = 122.50$ months, $SD = 22.17$ months) Controls: 21 English-speaking children ($M = 117.19$ months, $SD = 14.85$ months) Poor reading group: $n = 22$ Control group: $n = 21$
Outcomes	Anxiety (self-report on the revised Children's Manifest Anxiety Scale)
Notes	Nil

Table C13

Methods, participants, outcomes, and notes from Grills (2014)

Methods	<p>Treatment study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: A score of 20.5 words per minute on oral reading fluency (Continuous Monitoring of Early Reading Skills), or below 25th percentile for reading fluency (Test of Word Reading Efficiency)</p> <p>Recruits: 83 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported, but for the whole sample: <i>M</i> = 7.3 years, <i>SD</i> = 0.5 years)</p> <p>Controls: 31 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported, but for the whole sample: <i>M</i> = 7.3 years, <i>SD</i> = 0.5 years)</p> <p>Poor reading group: <i>n</i> = 83</p> <p>Control group: <i>n</i> = 31</p>
Outcomes	<p>Anxiety: anxiety, physical symptoms, harm avoidance, social anxiety, and separation anxiety/panic (The Multidimensional Anxiety Scale for Children)</p>
Notes	<p>Three groups of poor readers (poor fluency and decoding, poor fluency only, and responders to intervention) were combined as one group of “poor readers”</p> <p>Data was extracted from T1</p>

Table C14

Methods, participants, outcomes, and notes from Hoy (1997)

Methods	<p>Cross-sectional</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Reading achievement that was at least 1 1/3 SD below IQ. Reading was measured using subtests from the Woodcock Johnson Reading Achievement Battery</p> <p>Recruits: 57 English-speaking adults ($M = 22.41$ years, $SD = 3.81$ years)</p> <p>Controls: 140 English-speaking adults ($M = 22.17$ years, $SD = 5.0$ years)</p> <p>Poor reading group: $n = 57$</p> <p>Control group: $n = 140$</p>
Outcomes	<p>Anxiety: state anxiety, trait anxiety (The State Trait Anxiety Inventory), overall anxiety (The IPAT Anxiety Scale Questionnaire)</p>
Notes	<p>A second poor reading group was included (i.e., Learning Disabled College Group). However, this group was not combined with the Poor Reading group as examination of their mean reading test scores showed that their reading ability was not -1 SD below the average range.</p> <p>Raw data was also reported for STAI/ASQ Test and percentile ranges reported for STAI and ASQ</p>

Table C15

Methods, participants, outcomes, and notes from Hughes (2013)

Methods	Treatment study Country: United Kingdom
Participants	Reading criteria: Poor readers identified at school and confirmed by performance on tests of visual word recognition (British Ability Scale) Recruits: 19 English-speaking children (ranging from 11 to 12 years) Controls: 21 English-speaking children (ranging from 11 to 12 years) Poor reading group: $n = 19$ Control group: $n = 21$
Outcomes	Depression: depression (Children's Depression Inventory)
Notes	Data extracted from T1 T2 data requested but no response from author Internalising data excluded because it was a composite measure of internalising and externalising problems

Table C16

Methods, participants, outcomes, and notes from Martinez (2004)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: A score of 16-points or greater discrepancy between IQ and reading achievement</p> <p>Recruits: 30 English-speaking adolescents (range, <i>M</i> and <i>SD</i> not reported, but adolescents ranged from Grade 6 to 8)</p> <p>Controls: 30 English-speaking adolescents (range, <i>M</i> and <i>SD</i> not reported, but adolescents ranged from Grade 6 to 8)</p> <p>Poor reading group: <i>n</i> = 30</p> <p>Control group: <i>n</i> = 30</p>
Outcomes	<p>Anxiety: overall anxiety (Behavioural Assessment System for Children)</p> <p>Internalising: emotional symptoms (Self-Report of Personality)</p> <p>Depression: depression (Behavioural Assessment System for Children)</p>
Notes	<p>Language not reported, but English as a first language was presumed given the country and tests administered</p>

Table C17

Methods, participants, outcomes, and notes from MacPhail (2013)

Methods	Cross-sectional study Country: United States
Participants	Reading criteria: A score at or below the 25 th percentile on the vocabulary or comprehension subtest (Gates-MacGinitie Reading Test) Recruits: 58 English-speaking children (ranging from 8 to 11 years) Controls: 67 English-speaking children (ranging from 8 to 11 years) Poor reading group: $n = 58$ Control group: $n = 67$
Outcomes	Depression: negative affect (Positive and Negative Affect Schedule)
Notes	Age ranges were reported for both groups together, not separately Positive affect was also reported but not extracted as an outcome

Table C18

Methods, participants, outcomes, and notes from Maughan (2003)

Methods	<p>Longitudinal study</p> <p>Country: United Kingdom</p>
Participants	<p>Reading criteria: Severe and persistent reading problems were identified by scores with 6 or below on the California Achievement Test, and showed continuing reading difficulties at wave 2 (scores below 50th percentile)</p> <p>Recruits: 134 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported, but adolescents ranged from Grade 3 to 5)</p> <p>Controls: 1,282 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported, but adolescents ranged from Grade 3 to 5)</p> <p>Poor reading group: <i>n</i> = 134</p> <p>Control group: <i>n</i> = 1,282</p>
Outcomes	<p>Depression: depression (Short Version of the Mood and Feelings Questionnaire)</p>
Notes	<p>Male only sample</p> <p>Poor reading group = 9.1% of original sample</p> <p>Data was extracted from Wave 1</p>

Table C19

Methods, participants, outcomes, and notes from McGee (1986)

Methods	<p>Longitudinal study</p> <p>Country: New Zealand</p>
Participants	<p>Reading criteria: A reading score more than 1.5 standard errors below their reading score predicted from their performance when their 9- and 11- year reading performance was assessed</p> <p>Recruits: 40 English-speaking children (ranging from 5 to 11 years)</p> <p>Controls: 436 English-speaking children (ranging from 5 to 11 years)</p> <p>Poor reading group: $n = 40$</p> <p>Control group: $n = 436$</p>
Outcomes	<p>Anxiety: worry/fearfulness (Rutter Child Scales A), worry/fearfulness (Rutter Child Scales B)</p>
Notes	<p>We combined the “specific reading retarded” and “general reading backward” groups to create one “poor reading” group</p> <p>Data was extracted from the 7- year assessment only as this was the first time point where reading where reading and anxiety were measured together</p>

Table C20

Methods, participants, outcomes, and notes from Mercer (2005)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: A reading test score at or below 25th percentile on word reading subtest of the Wide Range Achievement Test</p> <p>Recruits: 56 English-speaking adolescents (ranging from 13 to 17 years)</p> <p>Controls: 25 English-speaking adolescents (ranging from 13 to 17 years)</p> <p>Poor reading group: $n = 56$</p> <p>Control group: $n = 25$</p>
Outcomes	<p>Anxiety: anxiety (Multidimensional Anxiety Scale for Children),</p> <p>Depression: depression (Reynolds Adolescent Depression Scale)</p>
Notes	<p>Study reported on three groups of poor readers. We included the “Low Word Reading Group only ($n = 56$) as this was the only group that had reported reading and internalising test data.</p>

Table C21

Methods, participants, outcomes, and notes from Miller (2005)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Standard scores <85 on a composite measure of basic reading skills</p> <p>Recruits: 24 English-speaking children and adolescents (ranging from 82 to 195 months)</p> <p>Controls: 55 English-speaking children and adolescents (ranging from 74 to 202 months)</p> <p>Poor reading group: $n = 24$</p> <p>Control group: $n = 55$</p>
Outcomes	<p>Anxiety: anxiety, somatisation (Behaviour Assessment System for Children – Parent Report), anxiety, somatisation (Behaviour Assessment System for Children – Teacher Report), anxiety (Revised Childhood Manifest Anxiety Scale)</p> <p>Depression: depression (Behaviour Assessment System for Children – Parent Report), depression (Behaviour Assessment System for Children – Teacher Report), depression (Childhood Depression Inventory)</p> <p>Internalising: internalising composite (parent report – measure not specified), internalising composite (teacher report – measure not specified)</p>
Notes	<p>Language not reported, but English as a first language was presumed given the country and tests administered</p> <p>Data not reported for anxiety, somatisation (Behaviour Assessment System for Children – Parent Report), anxiety, somatisation (Behaviour</p>

	<p>Assessment System for Children – Teacher Report), depression (Behaviour Assessment System for Children – Parent Report), depression (Behaviour Assessment System for Children – Teacher Report)</p> <p>Data for an internalising composite measure (parent and teacher report) were provided</p> <p>Two groups of poor readers were included in this study. However, the same participants were used in the separate analyses, just categorised according to different reading criteria. The first analysis was conducted based on the following reading criteria: A 20-point discrepancy between standard scores of intelligence and a composite reading score. Sub-average reading achievement was defined as a standard score of <85. We excluded this analysis from our review as the division of poor readers from the second model more closely reflected our poor reading criteria.</p>
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Table C22

Methods, participants, outcomes, and notes from Murray (1978)

Methods	<p>Cross-sectional study</p> <p>Country: United states</p>
Participants	<p>Reading criteria: A 2-year delay on tests of reading (visual word recognition, Wide Range Achievement Test; reading comprehension, Durrell Test and Gilmore Reading Test)</p> <p>Recruits: 104 English-speaking children (ranging from 8 to 15 years)</p> <p>Controls: 104 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported)</p> <p>Poor reading group: <i>n</i> = 104</p> <p>Control group: <i>n</i> = 104</p>
Outcomes	<p>Anxiety: anxiety (Manifest Anxiety Scale), test anxiety (Test Anxiety Scale for Children)</p> <p>Depression: depression (Behaviour Problem Check List)</p>
Notes	<p>Language not reported, but English as a first language was presumed given the country and tests administered</p> <p>Test anxiety (Test Anxiety Scale for Children) was measured but not included as an outcome measure in this study (as per our inclusion criteria)</p>

Table C23

Methods, participants, outcomes, and notes from Nelson (2017)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: At least two scores less than or equal to a standard score of 85 on norm referenced measures of reading and spelling.</p> <p>Reading status was confirmed on tests of basic reading skills, word reading, and pseudoword reading (Woodcock Johnson-III Diagnostic Reading Battery), word reading and phonological recoding (Test of Word Reading Efficiency).</p> <p>Recruits: 110 English speaking adults ($M = 19.75$ years, $SD = 1.71$ years)</p> <p>Controls: 110 English speaking adults ($M = 19.63$ years, $SD = 1.26$ years)</p> <p>Poor reading group: $n = 110$</p> <p>Control group: $n = 110$</p>
Outcomes	<p>Anxiety: anxiety (Behaviour Assessment System for Children, second edition self-report of Personality College)</p> <p>Depression: depression (Behaviour Assessment System for Children, second edition self-report of Personality College)</p>
Notes	<p>Nil</p>

Table C24

Methods, participants, outcomes, and notes from Nelson (2012)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Scores below the 25th percentile on two measures of real-word reading (Letter Word Identification Subtest of the Woodcock-Johnson III Test of Achievement), nonsense-word reading (Word Attack Subtest of the Woodcock Johnson III Test of Achievement) or reading fluency (Reading Fluency subtest of the Woodcock-Johnson III Test of Achievement), or on one of these measures and one measure of real-word spelling or nonsense-word spelling</p> <p>Recruits: 90 English-speaking adolescents and adults (ranging from 17 to 24 years)</p> <p>Controls: 60 English-speaking adolescents and adults (ranging from 17 to 24 years)</p> <p>Poor reading group: $n = 90$</p> <p>Control group: $n = 60$</p>
Outcomes	<p>Anxiety: anxiety (Beck Anxiety Inventory)</p> <p>Depression: depression (Beck Depression Inventory-Second Edition)</p>
Notes	<p>We combined the poor reading group ($N = 60$) and the comorbid ADHD and poor reading group ($N = 30$) to create one group of poor readers</p>

Table C25

Methods, participants, outcomes, and notes from Nelson (2015)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Poor readers scored at or below a standard score of 85 on a test of word recognition, decoding, or reading fluency. At least one score was below the cut off in the area of word recognition, decoding or reading fluency. A second score below the cut off in the area of spelling or timed reading comprehension.</p> <p>Recruits: 50 English-speaking adults (ranging from 18 to 26 years; $M = 20.36$ years, $SD = 1.69$ years)</p> <p>Controls: 50 English-speaking adults (ranging from 18 to 26 years, $M = 19.26$ years, $SD = 1.40$ years)</p> <p>Poor reading group: $n = 50$</p> <p>Control group: $n = 50$</p>
Outcomes	<p>Anxiety: worry, emotionality, and test anxiety (Test Anxiety Inventory), test anxiety (Adult Manifest Anxiety Scale)</p>
Notes	<p>Reading was not measured or reported for control participants but standardised test were administered, thus the poor reading group scores could be compared to normative test scores.</p>

Table C26

Methods, participants, outcomes, and notes from Plaisance (1994)

Methods	<p>Group comparison</p> <p>Country: United States</p>
Participants	<p>Reading criteria: participants were identified as reading disabled using an IQ discrepancy criteria. IQ above 85, a minimum 15-point discrepancy between the measure of intelligence and at least one achievement area. The mean of two qualifying reading scores were used as the best estimate of each student's reading achievement.</p> <p>Recruits: 50 English-speaking children (ranging from 8.5 to 13.5 years; $M = 11.0$ years, SD not reported)</p> <p>Controls: 58 English-speaking children (ranging from 8.3 to 13.1 years, $M = 10.5$ years, $SD =$ not reported)</p> <p>Poor reading group: $n = 50$</p> <p>Control group: $n = 58$</p>
Outcomes	<p>Anxiety: separation anxiety, overanxious disorder (parent behavioural questionnaire based on DSM-IV) overall anxiety (Comprehensive Behaviour Rating Scale for children)</p> <p>Depression: depression (Reynolds Child Depression Scale)</p>
Notes	<p>The reading test data for the control participants were not reported.</p> <p>However, standardised tests were used and poor reading test results could be compared to normative test data.</p>

Table C27

Methods, participants, outcomes, and notes from Pierce (2013)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Selection was restricted to participants who scored at or below the 25th percentile on one of the subtests or the composite from the TOWRE.</p> <p>Recruits: 47 English-speaking children (range, <i>M</i>, <i>SD</i> not reported.</p> <p>Grades reported as ranging from Grades 2 to 3)</p> <p>Controls: inappropriate control group: We used standardised normative data as control data.</p> <p>Poor reading group: <i>n</i> = 47</p> <p>Control group: <i>n</i> = 1,983</p>
Outcomes	<p>Anxiety: anxious/shy (The Conner's Teacher Rating Scale-Revised)</p> <p>Internalising: social problems (The Conner's Teacher Rating Scale-Revised)</p>
Notes	<p>The control data reported in this study was inappropriate for inclusion in this review. Rather we used data from the normative sample of standardised tests as the control group. Poor reading scores were consistent with inclusion criteria upon inspection of the poor readers reading test scores</p>

Table C28

Methods, participants, outcomes, and notes from Sanson (1996)

Methods	Longitudinal study Country: Australia
Participants	Reading criteria: Lowest one standard deviation (16%) of the distribution on the ACER Word Knowledge Test Recruits: 73 English-speaking children (ranging from 9 to 10 years when reading assessed) Controls: 42 English-speaking children (ranging from 9 to 10 years when reading assessed) Poor reading group: $n = 73$ Control group: $n = 42$
Outcomes	Anxiety: anxious-fearful (Rutter Child Behaviour Questionnaire-Scale A), anxious-fearful (Rutter Child Behaviour Questionnaire-B)
Notes	Poor reading ($N = 36$) and poor reading and behaviour problems ($N = 37$) groups were combined

Table C29

Methods, participants, outcomes, and notes from Scarborough (2003)

Methods	<p>Longitudinal study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: (1) regression based IQ discrepancy criterion, and (2) identified by school and assessed to determine if reading ability met regression criterion</p> <p>Recruits: 33 English-speaking children (range, <i>M</i> and <i>SD</i> not reported but children recruited from Grades 2, to 8)</p> <p>Controls: 28 English-speaking children (range, <i>M</i>, and <i>SD</i> not reported but children recruited from Grades 2, to 8)</p> <p>Poor reading group: <i>n</i> = 33</p> <p>Control group: <i>n</i> = 28</p>
Outcomes	<p>Internalising: internalising (Child Behaviour Check List), social problems (Child Behaviour Check List)</p>
Notes	<p>Poor readers IQ discrepancy group (<i>N</i> = 19) and special instruction group (<i>N</i> = 14) were combined to form one poor reading group</p> <p>Data extracted from T1</p>

Table C30

Methods, participants, outcomes, and notes from Snowling (2007)

Methods	<p>Cross-sectional analysis of longitudinal data</p> <p>Country: United Kingdom</p>
Participants	<p>Reading criteria: 66% of poor readers in this sample had reading and spelling one standard deviation below the mean of the control group</p> <p>Recruits: 21 English-speaking adolescents (ranging from 12 to 13 years at T1)</p> <p>Controls: 17 English-speaking adolescents (ranging from 12 to 13 years at T1)</p> <p>Poor reading group: $n = 21$</p> <p>Control group: $n = 17$</p>
Outcomes	<p>Internalising: emotional problems, peer problems (Strengths and Difficulties Questionnaire)</p>
Notes	<p>Poor reading group had significantly lower exception word reading, nonword reading, reading comprehension, and nonword and sight word reading fluency than the control group</p> <p>We extracted the data presented in Snowling (2007). Earlier T1-T3 reading data (but no internalising, anxiety or depression data) was reported in an earlier study (Gallagher et al., 2000)</p>

Table C31

Methods, participants, outcomes, and notes from Tomblin (2000)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: 16th percentile was used as a cut off score for both composite and subareas of word recognition and reading comprehension</p> <p>Recruits: 167 English-speaking children ($M = 7.95$, $SD = 0.36$ years.</p> <p><i>Note.</i> The additional data Tomblin provided was based on 174 participants)</p> <p>Controls: 417 English-speaking children ($M = 7.97$, $SD = 0.39$ years.</p> <p><i>Note.</i> The additional data Tomblin provided was based on 430 participants)</p> <p>Poor reading group: $n = 174$</p> <p>Control group: $n = 430$</p>
Outcomes	Internalising: internalising (Child Behaviour Checklist)
Notes	<p>The author was contacted to provide additional data for poor readers on the reading test measures and subscale scores of the Child Behaviour Checklist. The author provided this data on 30/11/2017</p>

Table C32

Methods, participants, outcomes, and notes from Willcutt (2013)

Methods	<p>Cross-sectional study</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Cut-off score of 1.25 standard deviations below the estimated population mean (equivalent to approximately 10th percentile) on an age-adjusted composite measure of word reading, reading recognition, and word reading (Peabody Individual Achievement Test)</p> <p>Recruits: 241 English-speaking children and adolescents (ranging from 8 to 15 years)</p> <p>Controls: 419 English-speaking children and adolescents (ranging from 8 to 15 years)</p> <p>Poor reading group: $n = 241$</p> <p>Control group: $n = 419$</p>
Outcomes	<p>Anxiety: generalised anxiety disorder (Diagnostic Interview for Children and Adolescents)</p> <p>Depression: major depression disorder (Diagnostic Interview for Children and Adolescents)</p> <p>Internalising: internalising (Achenbach System of Empirically Based Assessment)</p>
Notes	<p>Nil</p>

Table C33

Methods, participants, outcomes, and notes from Wu (2018a)

Methods	<p>Cross-sectional analysis from longitudinal dataset</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Definition of poor reading not included, but examination of reading scores shows that poor readers are more than one standard deviation below the control group on tests of word reading (PIAT), word reading (TOWRE), and reading comprehension (Gray Oral Reading Test)</p> <p>Recruits: 9 English-speaking children (age not reported for groups but overall age reported for sample $M = 11.84$ years, $SD = 2.30$; analyses was conducted at the end of 9th grade)</p> <p>Controls: 141 English-speaking children (age not reported for groups but overall age reported for sample $M = 11.84$ years, $SD = 2.30$; analyses was conducted at the end of 9th grade)</p> <p>Poor reading group: $n = 9$</p> <p>Control group: $n = 141$</p>
Outcomes	<p>Anxiety: generalised anxiety disorder (Diagnostic Interview for Children and Adolescents)</p> <p>Depression: major depression disorder (Diagnostic Interview for Children and Adolescents), withdrawal (Child Behavioural Checklist)</p> <p>Internalising: internalising (Child Behaviour Checklist)</p>
Notes	<p>We selected “class 4” as the most appropriate control group in the dataset. Class 3 reading scores were closer to one standard deviation above average on all measures</p>

Table C34

Methods, participants, outcomes, and notes from Wu (2018b)

Methods	<p>Cross-sectional analysis from longitudinal dataset</p> <p>Country: United States</p>
Participants	<p>Reading criteria: Definition of poor reading not included, but examination of reading scores shows that poor readers are more than one standard deviation below the control group on tests of word reading (WJ-III Word Identification and Word Attack; TOWRE), word reading fluency (WJ-III Reading Fluency), and phonological recoding (TOWRE)</p> <p>Recruits: 121 English-speaking children (age not reported for groups but overall age reported for sample $M = 15.45$ years, $SD = 0.33$; analyses was conducted at the end of 9th grade)</p> <p>Controls: 244 English-speaking children (age not reported for groups but overall age reported for sample $M = 15.45$ years, $SD = 0.33$; analyses was conducted at the end of 9th grade)</p> <p>Poor reading group: $n = 121$</p> <p>Control group: $n = 244$</p>
Outcomes	<p>Anxiety: somatic (Child Behavioural Checklist)</p> <p>Depression: withdrawal (Child Behavioural Checklist), social isolation (Colorado Learning Difficulties Questionnaire)</p> <p>Internalising: anxiety/depression subscale (Child Behavioural checklist)</p>
Notes	<p>Class 3 was selected as the most appropriate control group that did not include poor readers</p>

Supplementary Materials

Table S1

Description and rationale for examining the moderator variables in the relationship between poor reading and internalising problems.

Moderator	Rationale
Disorder subtype <ul style="list-style-type: none"> Anxiety disorder subtypes <ul style="list-style-type: none"> - Generalised - Separation - Social - Specific phobias - Panic disorder Depression disorder subtypes <ul style="list-style-type: none"> - Major depression - Persistent depression - Disruptive mood 	There are numerous anxiety and depression disorder subtypes. Some disorder subtypes (e.g., separation anxiety) may be associated with poor reading but not others (e.g., social anxiety). For example, Carroll et al. (2005) found poor readers are at risk for generalised and separation anxiety, but not specific phobias.
Poor reading subtype <ul style="list-style-type: none"> Phonological recoding Word recognition Fluency Mixed 	There are a number of different reading problems. Poor readers with poor visual word recognition have shown higher anxiety than typical readers (Carroll et al., 2005), while poor readers with poor reading fluency and phonological decoding did not report higher anxiety than controls (Grills et al., 2014).
Attention subtype <ul style="list-style-type: none"> Inattention Hyperactivity Combined 	Poor attention is associated with both poor reading and anxiety (Barbosa, Tannock, & Manassis, 2002; Barriga et al., 2002; Grills-Tauchel, Fletcher, Vaughn, Denton, & Taylor, 2013). Specifically, Carroll et al. (2005) found that poor readers with inattention had higher depression than typical readers. Willcutt et al. (2013) found poor readers with combined poor attention had higher depression but not anxiety.
Sex <ul style="list-style-type: none"> F > M M > F F = M 	Females experience higher rates of anxiety and depression than males (McLean, Asnanni, Litz, & Hoffmann, 2011). The role of sex in the relationship between poor reading and internalising problems is less clear. Nelson and Gregg (2012) found a stronger association between poor reading and depression in males than females.
Age <ul style="list-style-type: none"> Children 6-12 y Adolescents 13-18 y Adults 18+ y Mixed age 	Internalising disorders increase in prevalence with age, and research also suggests that there are some differences in the types of worries that younger and older children experience (Muris et al., 2000; Vasey et al., 1994). Anxiety disorders are also more prevalent in adults than children. In terms of poor reading, Boetsch et al. (1996) found a relationship between poor reading and depression in adult poor readers, but not in their sample of child poor readers.
Ethnicity <ul style="list-style-type: none"> Caucasian Hispanic Asian African-American Mixed ethnicity 	Different ethnicities have been associated with varying rates of internalising disorders. In terms of poor reading, Willcutt et al. (2013) found an association between poor reading and internalising problems in a Caucasian sample, while Grills et al. (2014) found no association between poor reading and anxiety in their predominantly African-American sample.
Type of informant <ul style="list-style-type: none"> Self Teacher Parent 	Information on internalising problems can be obtained from the person, parents, or teachers – and each informant provides a unique perspective on the internalising difficulties experienced. Research suggests that consistency between these informants is low, particularly between parents

<ul style="list-style-type: none">• Multi-informant	and children (Safford et al., 2005). In terms of poor readers, Maughan and Carroll (2006) suggest that parents may be unaware of the internalising problems experienced by poor readers, and rather, teachers may be more informative.
Type of internalising measure	Clinical interviews (i.e., categorical measures) assess for the presence or absence of anxiety or depression disorders, while questionnaires (i.e., dimensional measures) assess for constellations of general internalising symptoms.
<ul style="list-style-type: none">• Clinical interview• Questionnaire	

Table S2

Studies examining the association between poor reading and anxiety and each of the moderator variables, study name, sample size of poor readers (PR) and controls (C), the standardised mean differences (Cohen's d), and number of studies that examined each moderator (k)

Moderator	Study	Sample Size		Cohen's d	k
		PR	C		
Anxiety disorder subtype					
Generalised anxiety	Carroll, 2005	289	5,463	0.586	3
	Willcutt, 2013	241	419	0.516	
	Wu, 2018a	9	141	-0.252	
Separation anxiety	Carroll, 2005	289	5,463	0.586	1
Social anxiety					0
Panic disorder					0
Specific phobias	Carroll, 2005	289	5,463	0.586	1
Poor reading subtype					
Phonological recoding					0
Word recognition	Carroll, 2005	289	5,463	0.586	2
	Mercer, 2005	56	25	-0.138	
Reading fluency	Carroll, 2006	16	16	1.353	2
	Pierce, 2013	47	1,983	0.909	
Mixed poor reading	Aman, 1979	28	28	0.587	18
	Arnold, 2005	94	94	0.446	
	Chapman, 2004	19	55	0.086	
	Davis, 2017	22	21	0.868	
	Grills, 2014	83	31	-0.075	
	Hoy, 1997	57	140	0.373	
	Martinez, 2004	30	30	-0.029	
	McGee, 1986	40	436	0.462	
	Miller, 2005	24	55	0.416	
	Murray, 1978	104	104	0.325	
	Nelson, 2012	90	60	0.114	
	Nelson, 2015	50	50	0.414	
	Nelson, 2017	110	110	-0.018	
	Plaisance, 1994	50	58	0.878	
	Sanson, 1996	73	42	0.973	
	Willcutt, 2013	241	419	0.516	
	Wu, 2018a	9	141	-0.252	
	Wu, 2018b	121	244	0.442	
Attention subtype					
Inattention	Aman, 1979	28	28	0.587	3
	Pierce, 2013	47	1,983	0.909	
	Wu, 2018a	9	141	-0.252	
Hyperactivity	Carroll, 2005	289	5,463	0.586	2
	Wu, 2018b	121	244	0.442	
Combined	Arnold, 2005	94	94	0.446	5
	Chapman, 2004	19	55	0.086	
	McGee, 1986	40	436	0.462	
	Plaisance, 1994	50	58	0.878	
	Willcutt, 2013	241	419	0.516	
Sex					
M > F	Aman, 1979	28	28	0.587	11
	Arnold, 2005	94	94	0.446	

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	Carroll, 2005	289	5,463	0.586	
	Hoy, 1997	57	140	0.373	
	McGee, 1986	40	436	0.462	
	Mercer, 2005	56	25	-0.138	
	Miller, 2005	24	55	0.416	
	Murray, 1978	104	104	0.325	
	Pierce, 2013	47	1,983	0.909	
	Plaisance, 1994	50	58	0.878	
	Willcutt, 2013	241	419	0.516	
F > M	Carroll, 2006	16	16	1.353	2
	Nelson, 2017	110	110	-0.018	
M = F	Grills, 2014	83	31	-0.075	5
	Martinez, 2004	30	30	-0.029	
	Nelson, 2012	90	60	0.114	
	Nelson, 2015	50	50	0.414	
	Sanson, 1996	73	42	0.973	
Age					
Children	Aman, 1979	28	28	0.587	11
	Chapman, 2004	19	55	0.086	
	Davis, 2017	22	21	0.868	
	Grills, 2014	83	31	-0.075	
	McGee, 1986	40	436	0.462	
	Murray, 1978	104	104	0.325	
	Pierce, 2013	47	1,983	0.909	
	Plaisance, 1994	50	58	0.878	
	Sanson, 1996	73	42	0.973	
	Wu, 2018a	9	141	-0.252	
	Wu, 2018b	121	244	0.442	
Adolescents	Arnold, 2005	94	94	0.446	3
	Martinez, 2004	30	30	-0.029	
	Mercer, 2005	56	25	-0.138	
Adults	Carroll, 2006	16	16	1.353	4
	Hoy, 1997	57	140	0.373	
	Nelson, 2015	50	50	0.414	
	Nelson, 2017	110	110	-0.018	
Mixed	Carroll, 2005	289	5,463	0.586	4
	Miller, 2005	24	55	0.416	
	Nelson, 2012	90	60	0.114	
	Willcutt, 2013	241	419	0.516	
Ethnicity					
Caucasian	Aman, 1979	28	28	0.587	10
	McGee, 1986	40	436	0.462	
	Miller, 2005	24	55	0.416	
	Nelson, 2012	90	60	0.114	
	Nelson, 2015	50	50	0.414	
	Nelson, 2017	110	110	-0.018	
	Plaisance, 1994	50	58	0.878	
	Willcutt, 2013	241	419	0.516	
	Wu, 2018a	9	141	-0.252	
	Wu, 2018b	121	244	0.442	
African-American	Grills, 2014	83	31	-0.075	1
Hispanic	Pierce, 2013	47	1,983	0.909	1
Mixed	Arnold, 2005	94	94	0.446	2
	Martinez, 2004	30	30	-0.029	

Type of informant					
Self	Arnold, 2005	94	94	0.446	11
	Carroll, 2006	16	16	1.353	
	Davis, 2017	22	21	0.868	
	Grills, 2014	83	31	-0.075	
	Hoy, 1997	57	140	0.373	
	Martinez, 2004	30	30	-0.029	
	Mercer, 2005	56	25	-0.138	
	Murray, 1978	104	104	0.325	
	Nelson, 2012	90	60	0.114	
	Nelson, 2015	50	50	0.414	
	Nelson, 2017	110	110	-0.018	
Parent	Willcutt, 2013	241	419	0.516	2
	Wu, 2018a	9	141	-0.252	
Teacher	Aman, 1979	28	28	0.587	3
	Chapman, 2004	19	55	0.086	
Multi-informant	Pierce, 2013	47	1,983	0.909	6
	Carroll, 2005	289	5,463	0.586	
	McGee, 1986	40	436	0.462	
	Miller, 2005	24	55	0.416	
	Plaisance, 1994	50	58	0.878	
	Sanson, 1996	73	42	0.973	
	Wu, 2018b	121	244	0.442	
Type of anxiety measure					
Questionnaire	Aman, 1979	28	28	0.587	19
	Arnold, 2005	94	94	0.446	
	Carroll, 2006	16	16	1.353	
	Chapman, 2004	19	55	0.086	
	Davis, 2017	22	21	0.868	
	Grills, 2014	83	31	-0.075	
	Hoy, 1997	57	140	0.373	
	Martinez, 2004	30	30	-0.029	
	McGee, 1986	40	436	0.462	
	Mercer, 2005	56	25	-0.138	
	Miller, 2005	24	55	0.416	
	Murray, 1978	104	104	0.325	
	Nelson, 2012	90	60	0.114	
	Nelson, 2015	50	50	0.414	
	Nelson, 2017	110	110	-0.018	
	Plaisance, 1994	50	58	0.878	
	Pierce, 2013	47	1,983	0.909	
	Sanson, 1996	73	42	0.973	
	Wu, 2018b	121	244	0.442	
Clinical interview	Carroll, 2005	289	5,463	0.586	3
	Willcutt, 2013	241	419	0.516	
	Wu, 2018a	9	141	-0.252	

Table S3

Studies examining the association between poor reading and internalising and each of the moderator variables, study name, sample size of poor readers (PR) and controls (C), the standardised mean differences (Cohen's d), and number of studies that examined each moderator (k)

Moderator	Study	Sample Size		Cohen's d	k
		PR	C		
Poor reading subtype					
Phonological recoding					0
Word recognition	Carroll, 2005	289	5,463	0.454	1
Reading fluency	Pierce, 2013	47	1,983	0.610	1
Mixed poor reading	Arnold, 2005	94	94	0.195	12
	Boetsch, 1996a	18	18	0.881	
	Boetsch, 1996c	26	26	0.523	
	Chapman, 2004	19	55	0.371	
	Martinez, 2004	30	30	0.259	
	Miller, 2005	24	55	-0.069	
	Scarborough, 2003	33	28	0.347	
	Snowling, 2007	21	17	0.859	
	Tomblin, 2000	174	430	0.349	
	Willcutt, 2013	241	419	0.562	
	Wu, 2018a	9	141	0.591	
	Wu, 2018b	121	244	0.111	
Attention subtype					
Inattention	Pierce, 2013	47	1,983	0.610	2
	Wu, 2018a	9	141	0.591	
Hyperactivity	Carroll, 2005	289	5,463	0.454	3
	Snowling, 2007	21	17	0.859	
	Wu, 2018b	121	244	0.111	
Combined	Arnold, 2005	94	94	0.195	3
	Chapman, 2004	19	55	0.371	
	Willcutt, 2013	241	419	0.562	
Sex					
M > F	Arnold, 2005	94	94	0.195	6
	Boetsch, 1996a	18	18	0.881	
	Carroll, 2005	289	5,463	0.454	
	Miller, 2005	24	55	-0.069	
	Pierce, 2013	47	1,983	0.610	
	Willcutt, 2013	241	419	0.562	
F > M					
M = F	Boetsch, 1996c	26	26	0.523	4
	Martinez, 2004	30	30	0.259	
	Scarborough, 2003	33	28	0.347	
	Snowling, 2007	21	17	0.859	
Age					
Children	Chapman, 2004	19	55	0.371	6
	Pierce, 2013	47	1,983	0.610	
	Scarborough, 2003	33	28	0.347	
	Tomblin, 2000	174	430	0.349	
	Wu, 2018a	9	141	0.591	

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	Wu, 2018b	121	244	0.111	
Adolescents	Arnold, 2005	94	94	0.195	3
	Martinez, 2004	30	30	0.259	
	Snowling, 2007	21	17	0.859	
	Boetsch, 1996a	18	18	0.881	
Adults	Boetsch, 1996c	26	26	0.523	4
Mixed	Carroll, 2005	289	5,463	0.454	
	Miller, 2005	24	55	-0.069	
	Willcutt, 2013	241	419	0.562	
Ethnicity					
Caucasian	Martinez, 2004	30	30	0.259	5
	Miller, 2005	24	55	-0.069	
	Willcutt, 2013	241	419	0.562	
	Wu, 2018a	9	141	0.591	
	Wu, 2018b	121	244	0.111	
African-American					0
Hispanic	Pierce, 2013	47	1,983	0.610	1
Mixed	Arnold, 2005	94	94	0.195	1
Type of informant					
Self	Arnold, 2005	94	94	0.195	3
	Boetsch, 1996a	18	18	0.881	
	Martinez, 2004	30	30	0.259	
Parent	Boetsch, 1996c	26	26	0.523	5
	Scarborough, 2003	33	28	0.347	
	Snowling, 2007	21	17	0.859	
	Tomblin, 2000	174	430	0.349	
	Willcutt, 2013	241	419	0.562	
	Chapman, 2004	19	55	0.371	
Teacher	Pierce, 2013	47	1,983	0.610	2
Multi-informant	Carroll, 2005	289	5,463	0.454	
	Miller, 2005	24	55	-0.069	4
	Wu, 2018a	9	141	0.591	
	Wu, 2018b	121	244	0.111	
Type of anxiety measure					
Questionnaire	Arnold, 2005	94	94	0.195	14
	Boetsch, 1996a	18	18	0.881	
	Boetsch, 1996c	26	26	0.523	
	Carroll, 2005	289	5,463	0.454	
	Chapman, 2004	19	55	0.371	
	Martinez, 2004	30	30	0.259	
	Miller, 2005	24	55	-0.069	
	Pierce, 2013	47	1,983	0.610	
	Scarborough, 2003	33	28	0.347	
	Snowling, 2007	21	17	0.859	
	Tomblin, 2000	174	430	0.349	
	Willcutt, 2013	241	419	0.562	
	Wu, 2018a	9	141	0.591	
	Wu, 2018b	121	244	0.111	
Clinical interview					0

CHAPTER 3

Towards Understanding the Association between Poor Reading and Anxiety

Author's statement: DF was responsible for the content of this paper, for the data collection, and data analysis. GM and JH provided feedback on revisions of this paper.

ABSTRACT

There is reliable evidence for an association between poor reading and anxiety, but we do not yet understand why this association exists. Previous cross-sectional research suggests at least four variables that might act as causal "links" between poor reading and anxiety: poor reading self-concept, poor peer relations, poor attention, and poor behaviour. One aim of this study was to determine if any of these "linking variables" are associated with concomitant reading and anxiety problems in children. Previous research has also demonstrated that poor reading and anxiety are highly heterogeneous problems for children. Hence, a second aim of this study was to explore if concurrent reading and anxiety problems in children are associated with particular types of reading or anxiety symptoms. To address these aims, we compared the responses of children with poor reading and anxiety (i.e., experimental group) to a virtual control group (i.e., normative data), a reading control group (i.e., children with poor reading without anxiety), and an anxiety control group (i.e., children with typical reading and anxiety) on tests for four linking variables (reading self-concept, peer relations, attention, behaviour), for three reading skills (word accuracy, reading fluency, reading comprehension) and for six anxiety symptoms (social anxiety, separation anxiety, generalised anxiety, physical injury fears, panic/agoraphobia, obsessive-compulsive symptoms). The results suggest that concomitant reading and anxiety problems in children are associated with poor reading self-concept, social anxiety, poor attention, and multiple word accuracy reading problems. We discuss the theoretical and clinical implications of these findings.

Key Terms: poor reading; anxiety; profiling; heterogeneity; causal links.

INTRODUCTION

Poor reading in children

The reading abilities of around 16% of children fall below the average range for their age, and 5% of children have significant and severe reading problems (Louden et al., 2000; Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992). The nature of these reading problems differs between children (Castles & Coltheart, 1993; McArthur et al., 2013; Stuart & Stainthorp, 2016). Some children have a specific problem with "phonological recoding", which is the ability to learn to read new words using the grapheme-phoneme correspondences (i.e., GPCs; Stuart & Stainthorp, 2016; Temple & Marshall, 1983). Other children have a specific problem with "visual word recognition", the ability to learn to recognise whole written words from memory (Castles & Coltheart, 1993; Wang, Nickels, & Castles, 2015). Then there are children who have typically-developing phonological recoding and visual word recognition skills and yet cannot read fluently (i.e., poor reading fluency; Lovett, 1984; Morris et al., 1998). There are also children who cannot understand the meaning of texts even though they can read words accurately and fluently (i.e., "poor comprehenders"; Nation, Cocksey, Taylor, & Bishop, 2010; Nation & Snowling, 1997; Oakhill, 1994). It is important to note that the proportion of children who have these specific reading problems is relatively small, and the majority of poor readers have more than one of these reading problems (Castles & Coltheart, 1993; Goulandris & Snowling, 1991; McArthur et al., 2013; Peterson, Pennington, & Olson, 2013).

Anxiety in children

Anxiety is another common childhood problem, affecting more than 10% of children (Copeland, Angold, Shanahan, & Costello, 2014; Costello, Egger, & Angold, 2005). Like poor reading, anxiety comes in different forms. One of the most prevalent types of anxiety is social anxiety (e.g., worry about embarrassment in performance situations in front of peers

such as reading aloud, meeting new children, joining conversations; Lawrence et al., 2015). Social anxiety affects approximately 8.40% of Australians in their lifetime, and 2.30% of young Australians aged 4-to-17 years (Lawrence et al., 2015). Other types of anxiety include generalised anxiety (e.g., numerous and persistent worries about school performance, friendships, family matters, or daily activities), separation anxiety (e.g., worry about separation from parents or home, distress before school, difficulty spending time alone), and specific phobias (e.g., fear of specific situations or objects such as dogs, heights, doctors, or thunderstorms). Related anxiety disorders include obsessive-compulsive disorder (e.g., repetitive or intrusive thoughts or behaviours), and panic disorder with or without agoraphobia (e.g., sudden and intense onset of fear with or without the fear of being unable to escape; Diagnostic and Statistical Manual 5th edition (DSM-5), American Psychiatric Association (APA), 2013). Anxiety varies along a continuum which means that a child may have anxiety symptoms but not meet criteria for an anxiety disorder (Bell-Dolan & Strauss, 1990). Anxiety disorders also tend to be comorbid with other anxiety disorders. Three of the most common comorbid disorders are social anxiety, separation anxiety, and generalised anxiety disorders (Kendall et al., 2010; Kendall, Brady, & Verduin, 2001).

The association between poor reading and anxiety in children

Traditionally, poor reading and anxiety in children have been studied and treated independently. However, in recent times, both researchers and clinicians have become increasingly aware that poor readers are at elevated risk for anxiety (Carroll, Maughan, Goodman, & Meltzer, 2005; Galuschka & Schulte-Korne, 2016; Nelson & Gregg, 2012; Nelson, Lindstrom, & Foels, 2017; Willcutt et al., 2013). As a first step towards understanding the extent of this problem, we recently conducted a systematic review and meta-analysis of existing studies of anxiety in poor readers, along with studies that measured internalising problems (i.e., anxiety and depression combined; see Chapter 2). We discovered

a moderate and statistically reliable association between poor reading and internalising problems ($d = 0.41$) as well as anxiety ($d = 0.41$; Note: The identical effect sizes are not a typographical error). The association between poor reading and depression was statistically significant but small ($d = 0.23$). This suggests that anxiety may indeed be a problem for a notable proportion of poor readers (Francis, Caruana, Hudson, & McArthur, 2018).

A limitation of our systematic review was that all but one of the included studies were cross-sectional; that is, they compared measures of anxiety in a group (or groups) of poor readers to an appropriate control group. While such studies are a good starting point for understanding the association between two constructs, the outcomes provide little insight into why an association might exist. Critically, cross-sectional data cannot discern if one condition (e.g., poor reading) has a causal influence on a second condition (e.g., anxiety) or vice versa. Neither can it discern if a third variable (e.g., poor attention) simultaneously causes both conditions independently.

There are at least four causal hypotheses that could explain an association between poor reading and anxiety. One hypothesis is that poor reading causes anxiety via mechanisms such as poor peer relations or poor self-concept. Quantitative studies have revealed that children with poor reading are at heightened risk for victimisation and bullying from peers (Boyes, Leita, Claessen, Badcock, & Nayton, 2016) and experience peer relationship difficulties (Goldston et al., 2007; Martinez & Semrud-Clikeman, 2005; Morgan, Farkas, & Wu, 2012). Reading aloud paired with negative feedback from a teacher or ridicule from peers may cause children to perceive reading as a threat, and hence children may fear making reading mistakes in front of their peers. This may result in a negative self-assessment which in turn may lead to poor self-concept about reading, academic ability, or oneself in general (Chapman & Tunmer, 1995; Mercer, 2005; Morgan & Fuchs, 2007).

Sadly, victimisation (Craig, 1998; Storch & Masia-Warner, 2004), poor peer relations (Alfano, Beidel, & Wong, 2011; Flanagan, Erath, & Bierman, 2010; Ginsburg, La Greca, & Silverman, 1998; Verduin & Kendall, 2008) and poor self-concept (Grills & Ollendick, 2002; Lee & Hankin, 2009; Sowislo & Orth, 2013) are also associated with social anxiety. Given that social anxiety is the fear of negative evaluation, it is possible that social anxiety is associated with poor reading. In combination, this evidence could be interpreted as suggesting that poor reading may cause peer relation problems and poor reading self-concept which may in turn lead to anxiety/social anxiety (i.e., *poor reading* → *poor peer relations* → *poor reading self-concept* → *anxiety/social anxiety*).

An alternative causal explanation for the association between poor reading and anxiety is that anxiety causes poor reading via mechanisms such as poor attention or poor behaviour. In terms of attention, early research by Blau (1946) and Pond (1967) suggest that anxiety might cause poor attention which in turn may disrupt a child's capacity to learn in general, and hence their ability to learn to read. For example, children with anxiety/social anxiety may be hypervigilant to negative evaluation in the classroom which leads to avoidance (e.g., Mogg, Bradley, de Bono, & Painter, 1997) or attention directed towards negative thoughts or feelings or failure (e.g., Bogels & Mansell, 2004; Eysenck et al., 2007; Spurr & Stopa, 2002). These hypervigilant or self-focused behaviours may disrupt a child's ability to attend to information in the classroom and hence lead to poor reading. In terms of behaviour, children with anxiety have shown behaviour problems such as poor emotion regulation (e.g., inability to regulate emotions; Zeman, Shipman, & Suveg, 2002), information processing biases (e.g., interpret ambiguous situations negatively; Barrett, Rapee, Dadds, & Ryan, 1996), and aggression (e.g., behavioural outbursts; for a review see Fraire & Ollendick, 2013). Like poor attention, poor behaviour can interfere with a child's engagement in the classroom. Thus, there is indirect evidence to support the idea that anxiety/social anxiety may cause poor

attention or poor behaviour which alone, or together, might interfere with a child's engagement in learning at school, and hence learning to read (i.e., *anxiety/social anxiety* → *poor attention/behaviour* → *poor learning* → *poor reading*).

A third explanation for the association between poor reading and anxiety is that there is a bidirectional causal relationship between the two problems (Hinshaw, 1992; Olweus, 1983; Yasutake & Bryan, 1995). For example, a child's poor reading might lead to failure in the classroom that is readily apparent to the child. This leads to the development of poor reading self-concept (Chapman, Tunmer, & Prochnow, 2004) which makes the child hypersensitive to negative evaluation from others, which is social anxiety (Carroll et al., 2005). This heightened focus on potential negative evaluation – including how to avoid it – may lead to reduced attention to classroom activities (Bogels & Mansell, 2004; Mogg et al., 1997) and/or poor behaviour (Fraire & Ollendick, 2013). This would reduce learning opportunities, including reading practice, which in turn may trigger poor reading self-concept, which may exacerbate existing problems with anxiety or social anxiety.

A fourth causal explanation for the association between poor reading and anxiety is that a third variable may cause both conditions (Angold, Costello, & Erkanli, 1999). Candidate variables include each linking variable outlined above: poor reading self-concept, peer relation problems, poor attention, poor behaviour. In this case, one or more of these variables may cause simultaneous yet independent problems with reading and anxiety, creating a "faux" association between poor reading and anxiety.

An ideal way to test the four causal hypotheses proposed above would be a series of randomised controlled trials that assess the impact of independently improving poor reading, social anxiety, poor reading self-concept, poor peer relations, poor attention, or poor behaviour on each of the other variables in poor readers with anxiety. Unfortunately, no such series of studies exists. In fact, to our knowledge, only one intervention study has been

conducted with poor readers with anxiety. Grills and colleagues (2014) tested 153 Grade 1 students with poor reading on four anxiety measures (social anxiety, separation anxiety, physical symptoms, harm avoidance) before and after 30-minute small-group reading training classes held every school day for half a school year (Grills, Fletcher, Vaughn, Barth, Denton, & Stuebing, 2014). After the training, children were divided into four groups: poor readers with remaining fluency and decoding difficulties, poor readers with remaining fluency difficulties, children with resolved reading fluency difficulties (responders), and children with typical reading (controls). The outcomes showed that all groups, including controls, reported a decrease in self-reported physical anxiety symptoms and separation anxiety symptoms after training. Three groups also showed reductions in self-reported total anxiety symptoms and social anxiety symptoms (poor fluency and decoders, responders, controls). At first glance, these findings argue against a causal effect of reading on anxiety since the anxiety of responders did not improve more than that of the other groups. However, all poor reading groups had similar anxiety levels to the control group prior to intervention, and the responders made similar gains in reading to the control group, suggesting that this was simply a test-retest effect. Thus, this study does not represent a strong test of the causal influence of reading on anxiety in poor readers.

Given the shortage of intervention studies that can provide evidence for (or against) the four causal hypotheses outlined above, it is useful to consider longitudinal studies. Longitudinal studies allow us to examine the strength of an association between one variable at one point in time (e.g., reading) and another variable at another point in time (e.g., anxiety). To the best of our knowledge, only two longitudinal studies have examined associations between reading and anxiety – albeit in combination with behavioural problems. McGee and colleagues (1986) tracked reading, anxiety, behaviour, and attention in children with poor reading and typical reading across time (i.e., at ages 5, 7, 9, and 11; McGee,

Williams, Share, Anderson, & Silva, 1986). However, they did not measure the strength of the association between the different domains (e.g., reading at age 5) at later points in time (e.g., anxiety at age 7). Sanson, Prior, and Smart (1996) recruited groups of 7- to 8-year-old children with poor reading alone, with poor behaviour alone, with poor reading and poor behaviour, and with typical development. They conducted a retrospective analysis of their behaviour, anxiety, and attention at 1-3 years, 3-4 years, and 5-6 years. They found that poor readers did not differ from children with typical development on behaviour, anxiety, and attention at age 3-4, suggesting that these variables did not cause poor reading. However, like McGee and colleagues, they did not measure the strength of the association between these variables and later reading explicitly. Thus, existing longitudinal studies provide us with little insight into causal influences between poor reading and anxiety.

The current study

To summarise, the existing literature provides good evidence for a moderate and reliable association between poor reading and anxiety. However, we currently do not understand why this association exists. Previous cross-sectional studies suggest at least four variables that might causally link poor reading to anxiety, including poor reading self-concept, poor peer relations, poor attention, and poor behaviour. Thus, the first aim of this study was to determine if concomitant problems with reading and anxiety in children are associated with any of these linking variables. As discussed at the start of this chapter, previous research has also established that children's reading impairments and anxiety symptoms are highly heterogeneous. Thus, the second aim of this study was to explore if concomitant problems with reading and anxiety are associated with particular types of reading impairment or anxiety symptoms.

To address these aims, we compared the responses of children with poor reading and anxiety (i.e., experimental group) to a virtual control group (i.e., normative data), a reading

control group (i.e., children with poor reading without anxiety), and an anxiety control group (i.e., children with typical reading and anxiety) on measures of potential linking variables (reading self-concept, peer relations, attention, behaviour), of reading skills (word accuracy, reading fluency, reading comprehension), and of anxiety symptoms (social anxiety, generalised anxiety, separation anxiety, physical injury fears, panic/agoraphobia, obsessive-compulsive symptoms). The experimental group was compared to the virtual control group to identify reading, anxiety, or linking variables associated with concomitant reading and anxiety problems. The reading control and anxiety control groups were used to determine if any linking variables were associated with concomitant reading and anxiety problems specifically (i.e., present only in the experimental group) or with reading problems (i.e., also present in the reading control group) or anxiety (i.e. also present in the anxiety control group) more generally.

Based on existing research, we predicted that children with concomitant poor reading and anxiety would have atypical scores for all the linking variables (i.e., poor reading self-concept, poor peer relations, poor attention, poor behaviour) but that these atypical scores would also be found in the reading or anxiety control groups (Aim 1). Due to an absence of relevant studies, we were unable to make predictions about which types of poor reading or anxiety might be associated with concomitant reading and anxiety problems (Aim 2). Thus, outcomes for the second aim of this study were necessarily exploratory.

METHODS

The methods for this study were approved by the Macquarie University Human Ethics committee (Reference: 5201500286). Informed consent was obtained from all children and parents before participating in this study. Children and their parents were reimbursed \$30 for their time, and parents were given written reports of the results from the assessment.

Participants

Children and their parents were recruited from schools in the Sydney metropolitan area ($n = 5$), from the Macquarie University Reading Clinic (MURC; $n = 18$), and through online advertisements ($n = 71$). Children recruited through schools and online advertisements contacted the research team if they were interested in an assessment of their child's reading and emotional health, and the same advertisement was used to recruit all types of participants (see Appendix A for advertisement). Children recruited through the Clinic were invited to participate in the study if they had poor nonword or irregular word reading accuracy, and had been assessed for their reading by the Clinic in the past 6 months. In addition, children had to: (1) be aged between 8 and 12 years; (2) have no history of neurological or sensory impairment as indicated on a background questionnaire; and (3) use English as their primary language at school and at home.

Using these criteria, we initially recruited 94 children whom we tested on three "grouping" variables: the Nonword List of the Castles and Coltheart Reading Test 2 (CC2; Castles et al., 2009); the Irregular Word List also from the CC2; and the total and subscale scores on the parent version of the Spence Children's Anxiety Scale (SCAS-P; Nauta et al., 2004; see Reading Assessments sections below for details about each test). A child's reading was considered poor if they scored more than one standard deviation (1 SD) below the mean for their age for either nonword reading accuracy or irregular word reading accuracy. A child was considered to have anxiety if their total or subscale SCAS-P score was at least 1 SD above the mean for their age.

When we applied these grouping variables to our 94 initial recruits, we excluded 28 children who did not meet the grouping criteria. We also excluded one child who had missing data for the SCAS-P (Nauta et al., 2004). This left a sample of 65 children allocated to three groups: poor readers with anxiety (i.e., experimental group; $N = 34$), poor readers without

anxiety (i.e., reading control; $N = 14$), and typical readers with anxiety (i.e., anxiety controls; $N = 17$). The children in the experimental, reading control, and anxiety control groups were aged between 8 and 12 years ($M = 9.81$, $SD = 1.20$ months). There were 28 girls and 37 boys who attended Grades 2 to 6 in public ($n = 43$), Catholic ($n = 13$), or private or independent ($n = 8$) schools, and one child who was home schooled. The groups comprised children from each of the three recruitment sources: experimental group (clinic = 29.41%, advertisement = 67.64%, school = 2.94%), reading control (clinic = 7.14%, advertisement = 78.57%, school = 14.28%), and anxiety control (clinic = 17.64%, advertisement = 76.47%, school = 2.94%). The characteristics for the three groups are presented in Table 1 for participants in the experimental, reading control, and anxiety control groups.

Socioeconomic status (SES) was indexed by demographic information gathered on the general background questionnaire completed by parents. Most parents had good levels of education: 10 to 11 years: 4.25%; 12 years: 4.25%; skilled trade: 25.53%; university education: 65.95%. Their level of employment varied: casual (14.89%); full-time (23.40%); part-time (53.19%); and unemployed (8.50%). Their gross annual household income was generally high (i.e., greater than \$70,000): \$25,000 – \$45,000 (4.25%); \$45,000 - \$70,000 (17.02%); greater than \$70,000 (74.46%; Note: 4.25% of parents did not report their income). Parents identified as Australian (92.00%) or Eurasian, Maori, or other (8.00%).

Table 1. General characteristics of the three subgroups of children

		Group		
		Poor readers with anxiety	Poor readers without anxiety	Typical readers with anxiety
<i>N</i>		34	14	17
Age years	<i>M</i> (<i>SD</i>)	9.64 (1.18)	10.21 (1.37)	9.83 (1.40)
Sex				
	F	15	5	6
	M	19	9	11
Ethnicity				
	Australian	32	13	15
	New Zealand	0	1	0
	Eurasian	1	0	1
	Chinese	0	0	1
	Maori	1	0	0
Recruitment				
	Advertisement	23	11	13
	Clinic	10	1	3
	School	1	2	1
Assessment mode				
	Skype	7	0	0
	In Person	27	14	17
SES				
	High	26	9	11
	Moderate	6	3	2
	Low	1	0	1
	Did not report	1	2	3
Verbal skills	<i>M</i> (<i>SD</i>)	100.21 (14.76)	96.64 (15.22)	110 (9.57)

Note. Verbal skills scores are standardised scores ($M = 100$, $SD = 15$).

Procedure

In line with best practice at the MURC, children completed the reading assessments and questionnaires at either the MURC ($n = 54$) or via Skype ($n = 11$). Children who completed the Skype assessment received the test materials in the post, which were returned to the investigator via pre-paid post. There was a high response rate from the Skype assessments (97.50%). One participant did not return the completed assessment materials and hence, as mentioned above, was excluded for missing data. Parents who attended the Clinic completed the questionnaires in the waiting room, whilst parents of the Skype-assessment children

completed the questionnaires at home. Children completed the reading assessment and questionnaires in 2 hours. Parents completed the questionnaires in 30 minutes.

Reading assessments

Word accuracy

Reading accuracy for nonwords and irregular words. We used the pencil and paper version of the CC2 (Castles et al., 2009) to measure nonword and irregular word reading accuracy. The CC2 comprises three lists of words: (1) 40 regular words (e.g., marsh), which can be read accurately via phonological recoding or visual word recognition; (2) 40 nonwords (e.g., gop), which are nonsense words that can be read most accurately via phonological recoding; and (3) 40 irregular words (e.g., yacht), which can be read most accurately via visual word recognition. Each word is printed on a card. The words are presented in a fixed random order of increasing difficulty (e.g., easiest nonword, easiest irregular word, easiest regular word, easiest next regular word, easiest next nonword, easiest next irregular word). Children are asked to read items from all the lists until they make five consecutive errors within a list. After this, items from the discontinued list are skipped. Testing continues until all three lists have been discontinued, or all items have been administered. Scores are calculated by marking responses as correct (score of 1) or incorrect (score of 0). A total score for each list (maximum score of 40 per list) is tallied, and raw scores are converted into *z*-scores ($M = 0$, $SD = 1$). In terms of cut-off criteria, a *z*-score of below -1.00 indicates performance below the average range, a *z*-score of -1.0 to 1.0 indicates performance within the average range, and a *z*-score above 1.00 indicates performance above the average range.

The CC2 norms are based on a large Australian sample of children ($N = 1036$; Grade 1 to Grade 6) from lower to middle SES background (Castles et al., 2009). The psychometric properties for the CC2 are high, with sound internal consistency for the Irregular ($\alpha = 0.86$) and Nonword Reading Lists ($\alpha = 0.94$; Moore, Porter, Kohnen, & Castles, 2012). Test-retest

reliability, which is based on an 8 week no training period, is sound for the Irregular Word Reading List ($r = 0.94$) and the Nonword Reading List ($r = 0.80$).

Nonword spelling. Some cognitive skills involved in nonword spelling accuracy mirror those involved in nonword reading accuracy, and hence spelling tests also provide reliable and valid measures of the ability to read words accurately via phonological recoding. We used the nonword spelling subtest of the Queensland Inventory of Literacy (QUIL; Dodd, Holm, Oerlemans, & McCormick, 1996) to measure nonword spelling. The QUIL uses 24 nonwords of increasing difficulty to measure GPC knowledge (e.g., dorf, strimperdiction). The clinician reads each item twice and the child spells the item on the response sheet. All items are administered. Scores are calculated by marking responses as correct (score of 1) or incorrect (score of 0). The number of correct responses are tallied (maximum score of 24), and raw scores are converted into scaled scores ($M = 10$, $SD = 3$). In terms of cut-off criteria, a scaled score below 8 indicates performance below the average range, a score from 8 to 12 indicates performance within the average range, and a score above 12 indicates performance above the average range.

The QUIL includes Australian normative data for children aged 6 to 12 years of age. The nonword spelling subtest of the QUIL has sound internal consistency ($\alpha = 0.86$; Dodd et al., 1996). The QUIL itself does not report test-retest reliability for the nonword spelling subtest, but an estimate has been calculated from the performance of poor readers across an 8 week double baseline non-training period ($r_s = 0.63$; McArthur et al., 2015).

Irregular word spelling. Similar to nonword spelling, some cognitive skills involved in irregular word spelling accuracy mirror those involved in irregular word reading accuracy, and hence spelling tests also provide reliable and valid measures of the ability to read words accurately via visual word recognition. We used the Diagnostic Spelling Test for Irregular Words (DiSTi; Kohnen, Colenbrander, & Nickels, 2012) to measure irregular word spelling.

The DiSTi comprises 74 irregular sound-letter mappings (e.g., laugh, yacht). The clinician reads an item, uses the item in a sentence, and repeats the item one more time. The child then spells the item on a response sheet. The test is discontinued after five consecutive errors. Scores are calculated by marking responses as correct (1) or incorrect (0). The number of correct responses are tallied (maximum score of 74), and raw scores are converted to standardised z -scores ($M = 0$, $SD = 1$). In terms of cut-off criteria, a z -score of below -1.00 indicates performance below the average range, a z -score of -1.0 to 1.0 indicates performance within the average range, and a z -score above 1.00 indicates performance above the average range.

The DiSTi has Australian norms based on a sample of 645 children in Grades 1 to 7 from three schools in Sydney (Australia) located in lower to middle (two schools) and higher (one school) SES areas (Kohnen, Colenbrander, Krajenbrink & Nickels, 2015). The DiSTi has sound internal consistency ($\alpha = 0.94$), test-retest reliability ($r_S=0.96$), and construct validity ($r=0.61$; Kohnen et al., 2015).

Reading fluency

We used the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999) to measure nonword and word reading fluency. The TOWRE comprises two separate subtests: the Phonemic Decoding Efficiency subtest which contains 63 nonwords (e.g., pim, wum), and the Sight Word Efficiency subtest which comprises 104 regular and irregular words (e.g., book, children). In both subtests, children are asked to read a list of items as quickly as possible. The test is discontinued after 45 seconds or when the child has read all the words in the list. If a child is unsure of an item, after three seconds they are prompted to move onto the next item. Scores are calculated by marking responses as correct (1) or incorrect (0). Correct scores for the Phonemic Decoding Efficiency subtest (maximum score of 63) and the Sight Word Efficiency subtest (maximum score of 104) are tallied, and

raw scores are converted into standard scores ($M = 100$, $SD = 15$). In terms of cut-off criteria, a score below 85 indicates performance below the average range, a score from 85-115 indicates performance within the average range, and a score above 115 indicates performance above the average range.

There are Australian norms for the TOWRE which are based on a large sample ($N = 1146$) of primary school children (Marinus, Kohnen, & McArthur, 2013). Children were recruited from four independent schools in NSW located in average SES areas. The only psychometric properties for the TOWRE are based on US normative data (Torgesen et al., 1999). The test-retest reliability and construct and criterion validity data for the Sight Word Efficiency and Phonemic Decoding Efficiency subtests are greater than $\alpha = 0.90$ (Torgesen et al., 1999).

Reading comprehension

We used the Test of Everyday Reading Comprehension (TERC; McArthur, Jones, Anandakumar, Larsen, Castles, & Coltheart, 2013) to measure reading comprehension. The TERC comprises 10 picture items (e.g., a shopping list, a text message). Children are asked to read the text in each picture and answer two literal questions (e.g., “what kind of bread to you need to buy?”). The test is discontinued after three consecutive items are incorrect (i.e., six consecutive incorrect responses). Scores are calculated by marking a response as correct (1) or incorrect (0). The number of correct responses are tallied (maximum score of 20), and raw scores converted into standardised z -scores ($M = 0$, $SD = 1$). In terms of cut-off criteria, a z -score of below -1.00 indicates performance below the average range, a z -score of -1.0 to 1.0 indicates performance within the average range, and a z -score above 1.00 indicates performance above the average range.

The TERC has Australian norms based on a sample of 535 children (Grades 1 to 6) from two primary schools located in average SES areas in Sydney, Australia. The TERC has

good inter-rater reliability ($r = 0.99$), alternate-form reliability ($r = 0.86$; McArthur, Jones, Anandakumar, Larsen, Castles, & Coltheart, 2013), and strong correlations with the Neale Analysis of Reading Ability comprehension subtest ($r = 0.71$; Wheldall & McMurtry, 2014).

Anxiety assessments

The anxiety questionnaires were administered to children and their parents. For the child questionnaires, the clinician read each item aloud to the child so that they did not have to read the items themselves. Children responded by verbally indicating the appropriate choice (e.g., “number 1”, “never”). The clinician recorded the children’s responses by circling their answer on the response sheet. All children answered all questions, and many children commented that the questionnaires were easy to complete.

Generalised anxiety, separation anxiety, social anxiety, panic/agoraphobia, physical injury fears, and obsessive-compulsive symptoms

We used the Spence Children’s Anxiety Scale (SCAS) to measure child anxiety symptoms using questionnaires for children (SCAS-C; Spence, 1998) and parents (SCAS-P; Nauta et al., 2004). The SCAS-C comprises 44 items divided into six subscales that measure generalised anxiety (six items), separation anxiety (six items), social anxiety (six items), panic/agoraphobia (nine items), physical injury fears (five items), and obsessive-compulsive symptoms (six items). The questionnaire includes five positive items that aim to reduce negative response bias. Children respond to each question by indicating how often they experience the symptom (e.g., 0 = never, 1 = sometimes, 2 = often, 3 = always). The subscale scores are tallied according to the corresponding response rating (e.g., 0, 1, 2, 3). The six subscale scores are tallied to create the total score. Raw scores are converted into standardised *T*-scores ($M = 50$, $SD = 10$). *T*-scores above 60 are considered to be in the elevated range.

The SCAS-C has Australian norms from a large community sample of primary school children ($N = 4916$) aged 8 to 15 years old, selected from sociodemographic, ethnic, and metropolitan representative regions of Queensland, Australia. Children answered the questionnaire independently. The SCAS-C has good internal consistency ($\alpha > 0.60$; Spence, 1998), split half reliability ($\alpha = 0.92$), and convergent validity ($r = 0.75$; Spence, Barrett, & Turner, 2003). Test-retest estimates are derived over a 12-week period: Generalised anxiety ($r = 0.56$), social anxiety ($r = 0.57$), separation anxiety ($r = 0.57$), physical injury fears ($r = 0.54$), obsessive-compulsive symptoms ($r = 0.53$), panic/agoraphobia ($r = 0.45$) and total anxiety ($r = 0.60$; Spence, Barrett, & Turner, 2003).

The SCAS-P is the same as the SCAS-C except that items are rephrased appropriately for parents (e.g., “My child...”) and the positive items are excluded. We calculated standardised z-scores using appropriate normative data for the child’s age ($M = 0$, $SD = 1$). Scores score above 1.00 are considered to fall within the elevated range.

The SCAS-P was normed on a large Australian and Dutch community sample ($N = 745$) where parents reported on their children’s anxiety (children aged 6 to 18 years: $M = 10.80$ years, $SD = 2.40$ years; $n = 389$ boys, $n = 356$ girls). The SCAS-P has sound internal consistency for each subscale: separation anxiety ($\alpha = 0.76$), social phobia ($\alpha = 0.77$), generalised anxiety ($\alpha = 0.75$), panic and agoraphobia ($\alpha = 0.81$), obsessive-compulsive symptoms ($\alpha = 0.78$), and physical injury fears ($\alpha = 0.61$). Discriminant validity is also sound (Wilks lambda 0.65, $p < .001$). Test-retest reliability estimates are also sound and based on a three-month retest period for generalised anxiety ($r = 0.54$), social anxiety ($r = 0.82$), separation anxiety ($r = 0.84$), physical injury fears ($r = 0.85$), obsessive-compulsive symptoms ($r = 0.65$), panic/agoraphobia ($r = 0.53$), and total anxiety symptoms ($r = 0.81$).

Social anxiety

The Social Phobia and Anxiety Inventory (SPAI-C) is a measure of social anxiety that can be completed by both children (SPAI-C) and parents (SPAI-P; Beidel, Turner, Hamlin, & Morris, 2000). In the SPAI-C, children are asked to rate how often they feel nervous or scared in a particular social situation (e.g., 0 = never or hardly ever, 1 = sometimes, 2 = always or almost always) across 26 items. The total score is calculated by summing the corresponding response rating (e.g., 0, 1, 2). The raw score is evaluated against a clinical cut off point of 18, with scores equal to or above this cut-off point are considered elevated. The SPAI-C was normed on a community sample of children in Grade 4 to 6 ($N = 277$; Morris & Masia, 1998). The child version has sound internal consistency ($\alpha = 0.95$) and has demonstrated sound discriminant validity that distinguishes children with social anxiety from typical controls and children with other anxiety disorders (Beidel et al., 1995).

In the SPAI-P, parents are asked the same questions that have been rephrased appropriately for parents (i.e., “my child feels...”). Scoring and clinical cut-off points are identical to the child version. The parent version has sound internal consistency ($\alpha = 0.93$), but to date no test-retest estimates have been reported (Higa, Fernandez, Nakamura, Chorpita, & Daleiden, 2006).

Linking variables

Reading self-concept

We used the Reading Self-Concept Scale (RSCS; Chapman & Tunmer, 1995) to measure children’s perceptions of children’s reading ability. The RSCS comprises three subscales: perceived reading difficulty (10 items), perceived reading competence (10 items), and reading attitudes (10 items). Responses for each item are as follows: 1 = no, never; 2 = no, not usually; 3 = undecided; 4 = yes, usually; 5 = yes, always. The reading self-concept score is calculated by summing the three subscale scores and calculating the mean value for

the total score. A mean score was considered atypical if it is at least 1 SD below the score reported for the normative population ($M = 3.74$, $SD = 0.56$).

The normative data for the RSCS was derived from a large sample ($N = 771$) of primary-school students. Children were in Grades 1 to 5 and were selected from 16 schools (10 randomly selected) from varying SES areas in New Zealand. The RSCS has sound internal reliability for the reading self-concept subscale ($\alpha = 0.84$), however, there are currently no test-retest reliability estimates available for this measure (Chapman & Tunmer, 1995).

Peer relations

We used the peer problems subscale of the parent report version of the Strengths and Difficulties Questionnaire (SDQ-P; Goodman, 1997) to measure difficulties children have with their friendships (i.e., poor peer relations). The peer problem subscale comprises five items (e.g., “rather solitary, tends to play alone”; “has at least one good friend”; “generally liked by other children”; “picked on or bullied by other children”; “gets on better with adults than with other children”). For each item, parents indicate whether the statement reflects their child (e.g., 0 = not true, 1 = somewhat true, 2 = certainly true). Scores are calculated by tallying the response ratings (e.g., 0, 1, 2). Two items are reverse scored for the peer problems subscale (e.g., “has at least one good friend” and “generally liked by other children”; e.g., 2 = not true, 1 = somewhat true, 0 = certainly true). A score is considered elevated if at least 1 SD above the score reported for the normative population ($M = 1.60$, $SD = 1.90$).

Norms for the SDQ-P were developed from a large random sample of children aged 7 to 17 years ($N = 910$) attending 100 government schools in Victoria, Australia (hereafter the SDQ-P sample; Mellor, 2006). The selected schools were geographically representative of

the state. The Peer Problems subscale has sound internal consistency ($r = 0.53$) and test-retest reliability ($r = 0.66$; Stone, Otten, Engels, Vermulst, & Janssens, 2010).

Attention

We used the hyperactivity-inattention subscale of the SDQ-P to measure difficulties with attention (Goodman, 1997). The subscale comprises five items (e.g., “constantly fidgeting or squirming”; “restless, overactive”; “easily distracted, concentration wanders”; “thinks things out before acting”; “sees tasks through to the end”). Parents indicate to what extent the attention problems apply to their child (e.g., 0 = not true, 1 = somewhat true, 2 = certainly true). Two items are reverse scored (e.g., “thinks things out before acting” and “sees tasks through to the end”; 2 = not true, 1 = somewhat true, 0 = certainly true). Scores are calculated by tallying the corresponding response rating (e.g., 0, 1, 2). A score is considered elevated if it is at least 1 SD above the mean of the SDQ-P sample ($M = 3.10$, $SD = 2.40$; Mellor, 2006). The hyperactivity-inattention subscale has sound internal consistency ($r = 0.58$) and test-retest reliability ($r = 0.66$; Stone et al., 2010).

Behaviour

We used the conduct symptoms subscale of the SDQ-P to measure behaviour problems (Goodman, 1997). The behaviour problems scale comprises five items (e.g., “often has temper tantrums”; “generally obedient”; “often fights with other children”; “often lies or cheats”; “steals from home, school or elsewhere”). Parents indicate to what extent each behaviour problem applies to their child (e.g., 0 = not true, 1 = somewhat true, 2 = certainly true). One item is reverse scored for the behaviour problems subscale (e.g., “generally obedient”; 2 = not true, 1 = somewhat true, 0 = certainly true). Scores are calculated by tallying the corresponding response rating (e.g., 0, 1, 2). A score is considered elevated if it is at least 1 SD above the mean of the SDQ-P sample ($M = 1.50$, $SD = 1.60$; Mellor, 2006). The

behaviour problems subscale has sound internal consistency ($r = 0.76$) and test-retest reliability ($r = 0.71$; Stone et al., 2010).

RESULTS

The data analysis comprised four steps. We carried out these four steps twice: once using child-report questionnaire data and once using parent-report questionnaire data. The pattern of results was similar for both data sets. Below we outline the results using the parent-report questionnaire data as children with anxiety disorders tend to underreport anxiety symptoms (Schniering, Hudson, & Rapee, 2000), and parent-report data is considered more reliable when children are younger than 13 years (Grills & Ollendick, 2003; Rapee, Barrett, Dadds, & Evans, 1994). The results for the child report questionnaire data is provided in Appendix B.

In the first step of the analysis, we tested if the data sets for the experimental, reading control, and anxiety control groups were normally distributed (Note: Normative data sets used to represent the virtual control group were presumed to be normal distributed). This was tested using Shapiro-Wilk Tests with an alpha level of .05. The results of this normality test are shown in Tables 2 to 4 in row 5 (experimental group), 9 (reading control group) and 13 (anxiety control group; Note: bolded values in these rows indicate that the dataset deviated significantly from a normal distribution). The datasets that did not pass the test for normality were nonword spelling in the experimental group, behaviour for all three groups, reading self-concept in the reading control group, peer relations in the reading and anxiety control groups, and social anxiety (SPAI-P) in the reading control group. We used Mann-Whitney U Tests for group comparisons of these datasets in step four of this analysis. All other group comparisons used parametric independent-samples *t*-tests.

In the second step of the analysis, we used the mean scores of each group on each measure to identify atypical group performance on the linking variables, reading measures,

and anxiety measures. A group mean score was considered atypical if it fell 1 SD below (for reading and reading self-concept measures) or 1 SD above (for attention, behaviour, peer relations, and anxiety measures) the mean of the normative sample for each measure (see Tables 1 to 3 and row 1 for the normative means and SDs, and Tables 2 to 4 and row 2 for the 1 SD cut-off score for the linking variables). The experimental group had atypical scores for their nonword and irregular word reading accuracy, word and nonword reading fluency and spelling, reading comprehension, as well as their attention, reading self-concept, social anxiety, generalised anxiety, panic/agoraphobia, and obsessive-compulsive symptoms (see grey cells in row 3 of Tables 2 to 4). In contrast, the reading control group only had atypical mean scores for nonword reading accuracy, fluency, and spelling, and for reading self-concept (see grey cells in row 7 of Tables 2 to 4). The anxiety control group had atypical mean scores for generalised anxiety and social anxiety on the SCAS-P but not the SPAI-P. They did not have atypical scores for any other variables (see row 11 of Tables 2 to 4).

Since mean scores can be artificially inflated by outliers, and since a small minority of our datasets were not normally distributed, we tested the validity of the outcomes from the second step of the analysis by calculating the percentage of children in each group whose score exceeded the normative cut-off score for each measure (see rows 6, 10, and 14 in Tables 2 to 4). This revealed that the majority of children (i.e., over 50%) in each group had atypical scores for all bar one reading variable, two anxiety variables, and two linking variables that were also identified to have atypical means in the second step of the analysis. The five exceptions were atypical reading comprehension scores of the experimental group (47.10%), atypical panic/agoraphobia scores in the experimental group (41.17%), atypical obsessive-compulsive symptoms in the experimental group (29.41%), atypical reading self-concept scores in the reading control group (42.85% of the group), and atypical social anxiety in the anxiety control group (41.17%). Removing these from our list of atypical linking

variables suggested that the experimental group had atypical scores for their word and nonword reading accuracy, fluency, and spelling, reading self-concept, attention, social anxiety, and generalised anxiety; the reading control group had atypical mean scores for their nonword reading accuracy, fluency, and spelling; and the anxiety control group had mean atypical scores for generalised anxiety.

The aim of the fourth step of the analysis was to understand if each impaired variable in the experimental group was associated with concomitant reading and anxiety problems specifically (i.e., present only in the experimental group) or reading problems more generally (i.e. also present in the reading control group) or anxiety problems more generally (i.e., also present in the anxiety control group). The outcomes of the analyses thus far predicted that poor word reading accuracy, fluency, and spelling, reading self-concept, attention, and social anxiety would be unique to the experimental group while (1) poor nonword accuracy, fluency, and spelling would be common to both groups of poor readers, and (2) generalised anxiety would be common to both experimental and anxiety control groups. We tested this prediction using parametric or non-parametric tests (as appropriate) to compare the experimental and reading-control groups (see row 15 of Tables 2 to 4) and the experimental and anxiety control groups on these linking variables (see row 16 of Tables 2 to 4). The results showed that the experimental group had significantly poorer mean scores for irregular word reading accuracy, word reading fluency and spelling, generalised anxiety, and social anxiety than the reading control group (see row 15 of Tables 2 to 4). The results also showed that the experimental group had significantly poorer scores for reading self-concept and social anxiety than the anxiety control group (see row 16 of Tables 2 to 4).

Table 2

Descriptive and inferential statistics for the linking-variable measures for the four groups

Groups	Row	Statistics	Reading self-concept	Peer relations	Attention	Behaviour
Virtual controls (normative data)	1	M (SD)	3.74 (0.56)	1.60 (1.90)	3.10 (2.40)	1.50 (1.60)
	2	Cutoff	3.18	3.50	5.50	3.10
Experimental (poor readers with anxiety)	3	M	3.04	2.41	5.79	2.32
	4	SD	0.49	2.15	2.71	2.24
	5	SW	.96	.97	.95	.89
	6	%	58.82	32.35	50.00	23.53
Reading control (poor readers without anxiety)	7	M	3.15	1.50	4.57	1.43
	8	SD	0.45	1.34	3.55	1.40
	9	SW	.83	.85	.92	.86
	10	%	42.85	7.14	42.86	7.14
Anxiety control (typical readers with anxiety)	11	M	3.28	2.24	4.47	1.88
	12	SD	0.31	2.14	3.34	1.80
	13	SW	.95	.89	.90	.84
	14	%	41.17	35.29	41.17	17.65
Experimental vs reading control	15	<i>t</i> (df)	1.32 (46)	-1.46 (46)	1.38 (46)	1.29 (46)
Experiment vs anxiety control	16	<i>t</i> (df)	-3.07 (44)*	0.28 (49)	1.52 (49)	0.71(49)

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Grey cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

Table 3

Descriptive and inferential statistics for the reading measures for the four groups

			Word accuracy				Reading fluency		Reading comprehension
Groups	Row Statistics		Phonological recoding		Visual word recognition				
			Nonword reading	Nonword spelling	Irregular word reading	Irregular word spelling			
							Words	Nonwords	
Virtual controls (normative data)	1	M (SD)	0 (1)	10 (3)	0 (1)	0 (1)	100 (15)	100 (15)	0 (1)
	2	Cutoff	-1.00	7	-1.00	-1.00	85.00	85.00	-1.00
Experimental (poor readers with anxiety)	3	M	-1.42	5.23	-1.48	-1.03	78.88	79.91	-0.86
	4	SD	0.53	2.23	0.77	0.61	12.55	9.51	0.97
	5	SW	.97	.87	.95	.97	.94	.96	.96
	6	%	79.41	85.29	73.53	58.82	73.53	70.58	47.10
Reading control (poor readers without anxiety)	7	M	-1.37	5.57	-0.64	-0.56	93.71	83.43	-0.32
	8	SD	0.30	2.24	0.86	0.54	7.40	8.94	0.71
	9	SW	.90	.88	.93	.91	.96	.95	.92
	10	%	92.86	71.43	35.71	12.28	14.28	57.14	21.43
Anxiety control (typical readers with anxiety)	11	M	0.08	9.17	0.46	0.38	105.24	103.06	0.38
	12	SD	0.70	2.58	0.77	0.97	9.92	12.93	0.72
	13	SW	.96	.93	.95	.96	.92	.98	.97
	14	%	0.00	11.76	0.00	5.88	0.00	0.00	0.00
Experimental vs reading control	15	<i>t</i> (df)	-0.32 (46)	0.47 (46)	-3.36 (46)*	-2.52 (46)*	-5.07 (39)*	-1.18 (46)	-1.86 (46)
Experiment vs anxiety control	16	<i>t</i> (df)	-8.57 (49)*	-5.64 (49)*	-8.48 (49)*	-6.36 (49)*	-7.55 (49)*	7.25 (49)*	-4.64 (49)*

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Grey cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

Table 4

Descriptive and inferential statistics for the parent-reported anxiety measures for the four groups

Groups	Row	Statistics	Generalised anxiety	Separation anxiety	Social anxiety (SCAS)	Physical injury fears	Panic/agoraphobia	Obsessive compulsive	Total anxiety (SCAS)	Social anxiety (SPAI)
Virtual controls (normative data)	1	M (SD)	0 (1)	0 (1)	0 (1)	0 (1)	0 (1)	0 (1)	0 (1)	13.74 (8.5)
	2	Cutoff	+1.00	+1.00	+1.00	+1.00	+1.00	+1.00	+1.00	18
Experimental (poor readers with anxiety)	3	M	1.73	0.94	1.28	0.77	1.34	2.67	1.49	18.85
	4	SD	1.41	0.82	1.37	1.24	2.35	12.36	1.21	8.49
	5	SW	.87	.94	.95	.83	.79	.94	.89	.97
	6	%	76.47	50.00	50.00	44.12	41.17	29.41	50.00	55.88
Reading control (poor readers without anxiety)	7	M	-0.43	-0.53	-0.04	-0.37	-0.40	-0.45	-0.45	10.36
	8	SD	0.55	0.48	0.70	0.66	0.51	0.36	0.42	9.00
	9	SW	.92	.93	.95	.84	.70	.71	.92	.83
	10	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.14
Anxiety control (typical readers with anxiety)	11	M	1.20	0.59	1.16	0.49	0.80	0.99	0.83	13.88
	12	SD	1.24	1.06	0.28	1.19	1.33	0.24	0.95	11.37
	13	SW	.93	.96	.94	.94	.91	.92	.97	.92
	14	%	70.58	47.05	41.17	35.29	41.17	41.17	35.29	23.53
Experimental vs reading control	15	<i>t</i> (df)	7.62 (45.98)*	6.26 (46)*	3.43 (46)*	3.25 (46)*	4.10 (39.63)*	.94 (46)	8.21 (46.21) *	-3.09 (46)*
Experiment vs anxiety control	16	<i>t</i> (df)	1.33 (49)	1.30 (49)	2.52 (49)*	.76 (49)	.87 (49)	.62 (49)	1.95 (49)	1.75 (49)*

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Grey cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

DISCUSSION

The first aim of this study was to determine if concomitant problems with reading and anxiety in children are associated with problems in four potential linking variables. The second aim was to explore if concomitant reading and anxiety problems are associated with certain types of reading impairment or anxiety. In a four-step analysis, we compared an experimental group to a virtual control group, a reading control group, and an anxiety control group for different linking variables (poor reading self-concept, poor peer relations, poor attention, poor behaviour), reading skills (word accuracy, reading fluency, reading comprehension), and anxiety symptoms (social anxiety, generalised anxiety, separation anxiety, physical injury fears, panic/agoraphobia, obsessive-compulsive symptoms). Below, we use the outcomes of these analyses to address each aim in turn.

Aim 1: To determine if concomitant problems with reading and anxiety in children are associated with problems in any potential linking variables

As a group, poor readers with anxiety had an atypical mean score for attention and reading self-concept compared to the normative population (i.e., virtual controls). More than 50% of children in this group had atypical scores for reading self-concept and attention. The poor readers without anxiety (i.e., reading controls) also had an atypical mean score for reading self-concept compared to the normative population, but this score was not significantly higher (i.e., better) than the poor readers with anxiety. In terms of attention, neither control group showed atypical mean scores for attention, and there were no significant differences in attention between the three groups. The typical readers with anxiety (i.e., anxiety controls) did not have any atypical mean scores for linking variables, which were all significantly enhanced compared to poor readers with anxiety. Considered together, these results suggest that poor reading self-concept and poor attention are associated with

concomitant poor reading and anxiety in children, and hence are potential (but not yet proven) causal variables linking these problems.

Finding poor reading self-concept and poor attention in children with concomitant reading and anxiety problems aligns somewhat with previous studies that have reported associations between both poor reading and anxiety and poor general self-concept (e.g., Mercer, 2005; Morgan & Fuchs, 2007) and poor attention (Jarrett, Wolff, Davis, Cowart, & Ollendick, 2016; Willcutt & Pennington, 2000). In contrast, failing to find clear evidence for peer problems or poor behaviour in our poor readers with anxiety fails to support previous studies reporting these problems in poor readers (Arnold et al., 2005; Morgan et al., 2012; Willcutt & Pennington, 2000) or children with anxiety (Larson, Russ, Kahn, & Halfon, 2011; Verduin & Kendall, 2003).

One possible explanation for this discrepancy is how parents interpret children's symptoms. We measured peer problems and poor behaviour using a parent-report questionnaire. However, it is possible that teacher-report questionnaires provide better insight to children's peer relationships and behaviour in the classroom (Morgan, Farkas, Tufis, & Sperling, 2008). For instance, these problems may be more pronounced at school where the child experiences reading failure. Hence, parents may underreport peer problems and behaviour problems compared to teachers who observe these problems in the classroom. Thus, future research may consider evaluating differences between parent and teacher reports of peer problems and behaviour problems.

Aim 2: To explore if concomitant reading and anxiety problems are associated with certain types of poor reading or anxiety symptoms

Focusing first on reading, as a group, poor readers with anxiety had atypical mean scores for word and nonword reading accuracy, word and nonword spelling accuracy, word reading fluency, and reading comprehension. In addition, more than 50% of poor readers

with anxiety showed these reading difficulties with the exception of reading comprehension. Poor readers without anxiety (i.e., reading controls) also showed atypical mean scores for nonword reading accuracy, nonword spelling accuracy, and nonword fluency, again with more than 50% of individuals showing these difficulties. Interestingly, our reading controls only had mild problems with irregular word reading and spelling, and with word reading fluency. This explains why our poor readers with anxiety had significantly poorer mean scores for these visual word recognition measures than our reading controls. As expected, our typical readers with anxiety (anxiety controls) did not show atypical scores for any reading variable.

This pattern of reading outcomes was interesting for two reasons. First, it suggests that poor readers with anxiety have word reading accuracy problems that stem from problems with both phonological recoding (indexed by nonword reading and spelling) and visual word recognition (indexed by irregular word reading and spelling). This would make accurate word reading very difficult according to most evidence-based cognitive models of reading (e.g., the dual route model of reading aloud; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Second, it suggests that poor readers without anxiety (reading controls) tend to have more specific problems with phonological recoding. Previous studies have established that a minority of poor readers have a specific phonological recoding problem, which has been called phonological dyslexia (Castles & Coltheart, 1992; Castles, Datta, Gayan, & Olson, 1999; Coltheart, 1996; McArthur et al., 2013; Petersen, Pennington, & Olson, 2013). To our knowledge, this is the first study to find evidence that children with a specific reading deficit are less likely to have anxiety than children with multiple reading deficits, such as our poor readers with anxiety. Considered together, these reading outcomes suggest that concomitant problems with reading and anxiety in children are associated with word reading accuracy impairments stemming from both poor phonological recoding and poor visual word

recognition. Multiple reading accuracy impairments may be more obvious to a child and their significant others than a specific reading accuracy problem (e.g., poor phonological recoding), which may help explain why multiple reading accuracy impairments are more closely associated with anxiety in children.

Turning our focus to anxiety symptoms, our poor readers with anxiety had atypical mean scores for both measures of social anxiety (both the SCAS-P and SPAI-P) as well as generalised anxiety, panic/agoraphobia, and obsessive-compulsive symptoms. More than 50% of poor readers with anxiety had scores beyond the cut-off for generalised and social anxiety. Our children with typical reading and anxiety (anxiety controls) also had atypical mean scores for generalised and social anxiety (SCAS-P only), but generalised anxiety was the only anxiety symptom elevated in more than 50% of the group. The group comparisons between our poor readers with anxiety and the anxiety controls revealed a significant difference for social anxiety only. As expected, our poor readers without anxiety (reading controls) did not show atypical scores for any anxiety symptom. In combination, these anxiety outcomes clearly suggest that concomitant problems with reading and anxiety in children are associated with social anxiety.

In terms of social anxiety, our findings are consistent with two previous studies that found an association between poor reading and social anxiety (Carroll & Iles, 2006; Goldston et al., 2007), yet fail to support another study that did not find social anxiety in their sample of children with severe reading impairment (Grills et al., 2014). One possible explanation for this discrepancy is the age of the children and the developmental trajectory of anxiety. For instance, Grills and colleagues included children in Grade 1, a time at which separation anxiety is the most prevalent anxiety problem (Lawrence et al., 2015). In contrast, social anxiety tends to become a problem towards the latter stages of primary school (i.e., in the current study), as well as during adolescence (Goldston et al., 2007), and adulthood (Carroll

& Iles, 2006). Thus, the discrepancy of social anxiety in poor readers could be attributed to age and developmental trajectory of social anxiety disorder.

Theoretical implications

The results of this study suggest that children with concomitant poor reading and anxiety have problems with reading self-concept, attention, social anxiety, and multiple types of word reading accuracy. If there is a causal relationship between poor reading and anxiety, we might expect these variables to link together in a causal chain. We therefore cautiously hypothesise the following causal chain linking reading to anxiety. Children with both phonological recoding and visual word recognition problems repeatedly experience reading failure in the classroom (Riddick, Sterling, Farmer, & Morgan, 1999). These failures may become evident to the children themselves, which may lead them to form the (accurate) self-perception that they are poor readers (Chapman et al., 2001; Mercer, 2005; Morgan & Fuchs, 2007). This poor reading self-concept may trigger heightened awareness about the threat of negative evaluation from their peers and teachers about their reading, which is social anxiety. Their focus on potential negative evaluation and how to avoid it may interfere with their ability to pay attention to classroom activities (Bogels & Mansell, 2004; Mogg et al., 1997), which would reduce their reading practice. This in turn would cause a child to fall even further behind their peers in their reading skills, which may further erode their reading self-concept and heighten their social anxiety. Thus, a vicious cycle of failure is created and maintained over time. It is important to recognise that this causal hypothesis is based on cross-sectional data which cannot be used to demonstrate causality. Hence, this hypothesis, with its proposed mechanisms, needs to be tested in future interventional case series studies, randomised controlled trials, and longitudinal studies.

Clinical implications

The outcomes of this study provide interesting insights into how children with concomitant poor reading and anxiety might be assessed and treated in clinical practice. First, the results suggest that poor readers should be assessed for multiple types of reading and anxiety problems – particularly visual word recognition, phonological recoding, and social anxiety – to determine if they are at risk for concomitant poor reading and anxiety. They should also be tested for their reading self-concept and attention, which may link their poor reading to anxiety. When testing for reading self-concept problems, clinicians should read aloud items to poor readers and record their responses as these problems are measured using self-report questionnaires that need to be read by the child. When testing for poor reading, a parent-report questionnaire is suitable to gauge a child's problems with attention.

Second, clinicians should refer poor readers with concomitant reading and anxiety problems to appropriate therapists for intervention. Currently, the available evidence suggests that the only option for treating these problems is by treating poor reading and anxiety separately. In terms of reading, reading specialists should treat poor reading using evidence-based reading treatments that are selected to treat the specific problem of the poor reader. For instance, systematic phonics interventions should be used to treat poor phonological recoding (Ehri, Nunes, Stahl, & Willows, 2001; McArthur et al., 2012, 2018), and sight word training should be used to treat poor visual word recognition accuracy (Broom & Doctor, 1995; McArthur, Kohnen, Jones, Eve, Banales, Larsen, & Castles, 2015a; 2015b; Rouse & Wilshire 2007).

In terms of anxiety, clinicians should also treat anxiety problems using evidence-based anxiety treatments. The most effective anxiety intervention for childhood anxiety disorders is Cognitive Behavioural Therapy (CBT; Kendall, 2000). Childhood CBT interventions teach children general coping strategies to target any anxiety disorder (e.g., social anxiety disorder, generalised anxiety disorder, specific phobias, separation anxiety

disorder, panic disorder, or obsessive-compulsive disorder). In terms of social anxiety, recent research suggests specific CBT social anxiety treatments are more effective at reducing social anxiety than CBT interventions that target anxiety disorders in general (Ingul, Aune, & Nordahl, 2014; Leigh & Clark, 2016; Rapee, Gaston, & Abbott, 2009). The Cool Kids for Anxiety programme is an example of a CBT anxiety treatment that includes treatment components that focus on social anxiety (Hudson, Rapee, Deveney, Schniering, Lyneham, & Bovopoulos, 2009; Lyneham, Abbott, & Rapee, 2006; Mifsud & Rapee, 2005; Rapee, Abbott, & Lyneham, 2006). Thus, poor readers with anxiety can be treated using generic anxiety interventions, but children with social anxiety may benefit most from specific social anxiety interventions.

Psychologists can also use CBT to treat both poor reading self-concept and poor attention for poor readers with anxiety. Regarding self-concept, research suggests that integrating self-esteem building exercises into CBT sessions can be particularly effective for improving self-esteem outcomes (Emler, 2001). These self-esteem interventions should target the beliefs the child holds about their ability to learn to read. Regarding poor attention, recent meta-analyses have shown that CBT can effectively improve attention problems in children with attention deficit/hyperactivity disorder (Battagliese et al., 2015), as can medication for some children (van der Oord, Prins, Oosterlaan, & Emmelkamp, 2008). Such treatments might also be administered to children with poor reading.

In sum, current best practice for treating poor reading and anxiety dictates the use of separate evidence-based interventions to treat these problems, as well as concurrent treatment of poor reading self-concept and poor attention. It is important that psychologists are mindful that CBT interventions for childhood anxiety, self-concept, and attention problems are often delivered in written formats (i.e., manualised; Cool Kids for Anxiety; Lyneham, Abbott, Wignall, & Rapee, 2003). Hence, poor readers with anxiety will have considerable difficulty

accessing standard treatment materials (James, James, Cowdrey, Soler, & Choke, 2013).

Thus, clinicians and psychologists will need to modify treatment substantially to allow children to access these treatments.

Limitations

The application of these findings to future research and clinical practice must be considered within the context of the strengths and weaknesses of this study. First and foremost, as discussed above, our data is based on a cross-sectional analysis and hence is correlational in nature. It cannot be used to test causal links between variables, which is why we proposed the aforementioned hypothesis with caution.

Second, many studies examining the association between poor reading and anxiety have a small sample size. Initially, this study recruited a relatively large number of poor readers. However, we divided our sample into three smaller subgroups, which reduced the power of our analyses. The fact that our key findings were demonstrated across multiple metrics in our four-step analysis, and by numerous measures of each metric (e.g., phonological recoding and visual word recognition were each assessed by three measures, and social anxiety by two measures), provides some reassurance about the reliability of the outcomes. However, it is important that future studies use larger groups of poor readers with and without anxiety to ascertain the reliability of our findings.

Dividing our sample into three smaller subgroups also resulted in three unequal groups of children. The experimental group (i.e., poor readers with anxiety) had more than twice as many children ($N = 34$) as the poor reading control group (i.e., poor readers without anxiety; $N = 14$). This reduced the power of our analysis and increased the risk of a Type I error. To reduce this risk, we used non-parametric statistics if data for each group was not normally distributed. We also compared our experimental group data to normative control data (virtual controls) which is based on large samples of typically developing children and

hence considered reliable. Nevertheless, it would be ideal if future studies recruited groups with samples of a similar size.

A fourth limitation of this study was the use of multiple comparisons. To minimise the risk of Type 1 error, we restricted the number of measures to a minimum number required to address our aims. However, this study is the first to attempt to identify the reading, anxiety, and linking variables that are associated with concomitant reading and anxiety problems in children, and hence there were few previous findings to help narrow our focus to a small number of variables. Again, the fact that our effects were confirmed across multiple analysis steps and multiple tests provides some reassurance that random Type 1 errors were minimal. Nevertheless, it would be useful if future studies used our findings to better focus on critical variables (i.e., word accuracy, social anxiety, reading self-concept, attention) to minimise multiple comparisons.

A fifth potential limitation of this study was the use of questionnaires to assess anxiety symptoms and the linking variables (poor reading self-concept, poor peer relations, poor attention, poor behaviour). Questionnaires provide dimensional information on a range of symptoms but do not indicate the clinical severity of the problem. Diagnostic interviews are preferred to questionnaires to measure clinical severity as they assess a greater range of symptoms and provide a more sensitive measure of the severity of those symptoms. However, diagnostic interviews are typically more expensive than questionnaires since they often have to be administered by qualified experts over several hours. Diagnostic interviews can also be more subjective than questionnaires, since an expert has to use their clinical judgement to evaluate the reliability of child and parent responses in order to score an interviewee's performance. Given these limitations of diagnostic interviews, we opted to use questionnaires to conduct the first exploration of anxiety and linking variables in poor readers

with anxiety. It would be useful if future studies tested the reliability of our findings by investing in clinical interviews as well questionnaires of anxiety symptoms.

A sixth aspect of this study that may be perceived as a limitation is our use of some measures for both recruitment and outcome assessment. Specifically, we used the Nonword and Irregular Word Lists of the CC2 (Castles et al., 2009) to both recruit children and to index their phonological recoding and visual word recognition accuracy. Similarly, we used the subscales of the SCAS-P to both recruit children and index their various anxiety symptoms. We used multiple subtests to recruit and assess children with reading and anxiety in order to cater for the heterogeneous nature of reading and anxiety problems in children. This heterogeneity means that no one recruitment measure is sensitive to all reading or anxiety problems in children. Our approach results in a heterogeneous sample whose mean responses on assessments are less biased than a sample recruited with, say, one test of reading and one test of anxiety. This latter approach artificially reduces the heterogeneity of the sample and biases outcomes in favour of the recruitment measures. We acknowledge that neither approach is without its limitations, but we believe that by maximising heterogeneity during recruitment, we also minimised bias in all measures, including those used for recruitment.

Related to the assessment tools administered in this study, it is practically important to acknowledge the real world application of our assessment procedures. These tools provided a comprehensive overview of the child's reading and emotional health profile. Practically however, it is not feasible in terms of time, cost, and resources for psychologists, teachers, and counsellors to administer such a large battery of measures to children. Thus, we recommend assessing for word reading accuracy, word reading fluency, and reading comprehension to assess for reading difficulties. We also advocate assessing for anxiety

using a diagnostic interview. As the minimum, measuring these skills provides a more concise yet still comprehensive overview of the child's reading and emotional health.

Summary

The aims of this study were to determine if concurrent reading and anxiety problems in children were associated with certain linking variables that may causally link poor reading with anxiety (Aim 1) or particular types of reading impairments or anxiety symptoms (Aim 2). Comparing children with poor reading and anxiety to virtual controls (normative data), reading controls, and anxiety controls revealed that concomitant reading and anxiety problems in children are specifically associated with poor reading self-concept, social anxiety, poor attention, and poor word accuracy reading. These findings tentatively suggest a causal chain of events leading from poor reading to anxiety and then back to poor reading. The outcomes also suggest ways in which we can improve our clinical support of children with concomitant reading and anxiety problems, which is the focus of the chapter that follows.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.
- Alfano, C., Beidel, D., & Wong, N. (2011). Children with generalised anxiety disorder do not have peer problems, just fewer friends. *Child Psychiatry of Human Development*, 42, 712-723. doi: 10.1007/s10578-011-0245-2.
- Angold, A., Costello, E.J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology and Psychiatry*, 40, 57–87. doi: 10.1111/1469-7610.00424
- Arnold, E. M., Goldston, D. B., Walsh, A. K., Reboussin, B. A., Daniel, S. S., Hickman, E., & Wood, F. B. (2005). Severity of emotional and behavioural problems among poor and typical readers. *Journal of Abnormal Child Psychology*, 33, 205-217. doi: 10.1007/s10802-005-1828-9
- Barrett, P. M., Dadds, M. R., & Rapee, R. M., & Ryan, S. (1996). Family treatment of childhood anxiety: A controlled trial. *Journal of Consulting and Clinical Psychology*, 64, 333-342. doi: 10.1037/0022-006X.64.2.333
- Battagliese, G., Caccetta, M., Luppino, O. I., Baglioni, C., Cardi, V., Mancini, F. et al. (2015). Cognitive-behavioural therapy for externalising disorders: A meta-analysis of treatment effectiveness. *Behaviour Research and Therapy*, 75, 60-71. doi: 10.1016/j.brat.2015.10.008
- Beidel, D. C., Turner, S. M., Hamlin, K., & Morris, T. L. (2000). The Social Phobia Anxiety Inventory for Children (SPAI-C): External and discriminative validity. *Behavior Therapy*, 31, 75–87. doi: 10.1016/S0005-7894(00)80005-2
- Beidel, D. C., Turner, S. M., & Morris, T. L. (1995). A new inventory to assess childhood social anxiety and phobia: The social phobia and anxiety inventory for children. *Psychological Assessment*, 7, 73-79. doi: 10.1037/1040-3590.7.1.73

- Bell-Dolan, D. J., Last, C. G., & Strauss, C. C. (1990). Symptoms of anxiety disorders in normal children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29, 759-765. doi: 10.1097/00004583-199009000-00014
- Blau, A. (1946). *The Master Hand. Research Monographs No. 5*. American Orthopsychiatric Association, New York.
- Bogels, S. M., & Mansell, W. (2004). Attention processes in the maintenance and treatment of social phobia: Hypervigilance, avoidance, and self-focused attention. *Clinical Psychology Review*, 827-856. doi: 10.1016/j.cpr.2004.06.005
- Boyes, M. E., Leita, S., Claessen, M., Badcock, N. A., & Nayton, M. (2016). Why are reading difficulties associated with mental health problems? *Dyslexia*, 22, 263-266. doi: 10.1002/dys.1531
- Broom, Y. M. & Doctor, E.A. (1995). Developmental surface dyslexia: A case study of the efficacy of a remediation programme. *Cognitive Neuropsychology*, 12, 69–110. doi: 10.1080/02643299508251992
- Carroll, J. M., & Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology*, 76, 651-662. doi: 10.1348/000709905X66233
- Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, 46, 524-532. doi: 10.1111/j.1469-7610.2004.00366.x
- Castles, A., & Coltheart, M. (1993). Varieties of developmental dyslexia. *Cognition*, 47, 149-180. doi: 10.1016/0010-0277(93)90003-E
- Castles, A., Coltheart, M., Larsen, L., Jones, P., Saunders, S., & McArthur, G. (2009). Assessing the basic components of reading: A revision of the Castles and Coltheart

- test with new norms. *Australian Journal of Learning Difficulties*, 14, 67-88. doi: 10.1080/19404150902783435
- Castles, A., Datta, H., Gayan, J., & Olson, R. K. (1999). Varieties of developmental reading disorder: Genetic and environmental influences. *Journal of Experimental Child Psychology*, 72, 73-94. doi: 10.1006/jecp.1998.2482
- Chapman, J. W., & Tunmer, W. E. (1995). Development of young children's reading self-concepts: An examination of emerging subcomponents and their relationship with reading achievement. *Journal of Educational Psychology*, 87, 154-167. doi: 10.1037/0022-0663.87.1.154
- Chapman, J. W., Tunmer, W. E., & Prochnow, J. E. (2004). Repressed resilience? A longitudinal study of reading, self-perceptions and teacher behaviour ratings of poor and average readers in New Zealand. *Journal of the International Academy for Research in Learning Disabilities*, 22, 9-15. Retrieved from www.iarld.com/the-journal-thalamus
- Coltheart, M. (1996). Phonological dyslexia: Past and future issues. *Cognitive Neuropsychology*, 13, 749-762. doi: 10.1080/026432996381791
- Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, 108, 204-256. doi: 10.1037/0033-295X.108.1.204
- Copeland, W. E., Angold, A., Shanahan, L., & Costello, E. J. (2014). Longitudinal patterns of anxiety from childhood to adulthood: The great smoky mountains study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 53, 21-33. doi: 10.1016/j.jaac.2013.09.017

- Craig, W. M. (1998). The relationship among bullying, victimization, depression, anxiety, and aggression in elementary school children. *Personality and Individual Differences*, 24, 123-130. doi: 10.1016/S0191-8869(97)00145-1
- Dodd, B., Holm, A., Oerlemans, M., & McCormick, M. (1996). *Queensland Inventory of Literacy (QUIL)*. Brisbane, Australia: University of Queensland.
- Ehri, L.C., Nunes, S.R., Stahl, S.A., & Willows, D.M. (2001). Systematic phonics instruction helps students learn to reading: evidence from the national reading panel's meta-analysis. *Review of Educational Research*, 71, 393–447. doi: 10.3102/00346543071003393
- Emler, N. (2001). *Self-esteem: The costs and causes of low self-worth*. York: Joseph Rowntree Foundation.
- Eysenck, M.W., Santos, R., Derekeschan, N., & Calvo, M.G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, 7, 336–353. doi: 10.1037/1528-3542.7.2.336
- Flanagan, K. S., Erath, S. A., & Bierman, K. L. (2010). Unique associations between peer relations and social anxiety in early adolescence. *Journal of Clinical Child & Adolescent Psychology*, 37, 759-769. doi: 10.1080/15374410802359700
- Fraire, M. G., & Ollendick, T. H. (2013). Anxiety and oppositional defiant disorder: A transdiagnostic conceptualisation. *Clinical Psychology Review*, 33, 229-240. doi: 10.1016/j.cpr.2012.11.004
- Francis, D. A., Caruana, N., Hudson, J. L., & McArthur, G. M. (2018). The association between poor reading and internalising problems: A systematic review and meta-analysis. *Clinical Psychology Review*, 57, 45-60. doi: 10.1016/j.cpr.2018.09.002

- Galuschka, K., & Schulte-Körne, G. (2016). Clinical practice guideline: The diagnosis and treatment of reading and/or spelling disorders in children and adolescents. *Deutsches Arzteblatt International*, 113, 279-286. doi: 10.3238/arztebl.2016.0279
- Ginsburg, G. S., La Greca, A. M., & Silverman, W. K. (1998). Social anxiety in children with anxiety disorders: Relation with social and emotional functioning. *Journal of Abnormal Child Psychology*, 26, 175–185. doi: 10.1023/A:1022668101048
- Goldston, D. B. et al. (2007). Reading problems, psychiatric disorders, and functional impairment from mid to late adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry*, 46, 25-33. doi: 10.1097/01.chi.0000242241.77302.f4
- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38, 581-586. doi: 10.1111/j.1469-7610.1997.tb01545.x
- Grills, A. E., Fletcher, J. M., Vaughn, S., Barth, A., Denton, C. A., & Stuebing, K. K. (2014). Anxiety and response to reading intervention among first grade students. *Child Youth Care Forum*, 43, 417-431. doi: 10.1007/s10566-014-9244-3
- Grills, A. E., & Ollendick, T. H. (2002). Issues in parent-child agreement: The case of structured diagnostic interviews. *Clinical Child and Family Psychology Review*, 5, 57-83. doi: 10.1023/A:10145737
- Hinshaw, S. P. (1992). Externalizing behaviour problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. *Psychological Bulletin*, 111, 127-155. doi: 10.1037/0033-2909.111.1.127
- Higa, C. K., Fernandez, S. N., Nakamura, B. J., Chorpita, B. F., & Daleiden, E. L. (2006). Parental assessment of childhood social phobia: Psychometric properties of the social phobia and anxiety inventory for children-parent report. *Journal of Clinical Child and Adolescent Psychology*, 35, 590-597. doi: 10.1207/s15374424jccp3504_11

- Hudson, J.L., Rapee, R.M., Deveney, C., Schniering, C.A., Lyneham, H., & Bovopoulos, N. (2009). Cognitive behavioural treatment versus an active control for children and adolescents with anxiety disorders: A randomised trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48, 533-544. doi: 10.1097/CHI.0b013e31819c2401
- Ingul, J. M., Aune, T., & Nordahl, H. M. (2014). A randomised controlled trial of individual cognitive therapy, group cognitive behaviour therapy and attentional placebo for adolescent social phobia. *Psychotherapy and Psychosomatics*, 83, 54-61. doi: 10.1159/000354672
- Jarrett, M. A., Wolff, J. C., Davis, T. E., Cowart, M. J., & Ollendick, T. H. (2016). Characteristics of children with ADHD and comorbid anxiety. *Journal of Attention Disorders*, 20, 636-644. doi: 10.1177/1087054712452914
- Kendall, P.C. (Ed.) (2000). *Child and adolescent therapy: cognitive-behavioural procedures* (2nd ed.). New York: Guilford Press.
- Kendall et al. (2010). Clinical characteristics of anxiety disordered youth. *Journal of Anxiety Disorders*, 24, 360-365. doi: 10.1016/j.janxdis.2010.01.009.
- Kendall, P. C., Brady, E. U., & Verduin, T. L. (2001). Comorbidity in childhood anxiety disorders and treatment outcome. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 787-794. doi: 10.1097/00004583-200107000-00013
- Kohnen, S., Colenbrander, D., Krajenbrink, T., & Nickels, L. (2015). Assessment of lexical and non-lexical spelling in students in Grades 1-7. *Australian Journal of Learning Difficulties*, 20, 15-38. doi: 10.1080/19404158.2015.1023209
- Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.

- Larson, K., Russ, S. A., Kahn, R. S., & Halfon, N. (2011). Patterns of comorbidity, functioning, and service use for US children with ADHD, 2007. *Pediatrics*, 127, 462-470. doi: 10.1542/peds.2010-0165
- Lawrence, D., Johnson, S., Hafekost, J., de Haan, K. B., Sawyer, M., Ainley, J., & Zubrick, S. R. (2015). *The mental health of children and adolescents: Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Canberra, Australia: Department of Health.
- Lee, A., & Hankin, B. L. (2009). Insecure attachment, dysfunctional attitudes, and low self-esteem predicting prospective symptoms of depression and anxiety during adolescence. *Journal of Clinical Child and Adolescent Psychology*, 38, 219 –231. doi:10.1080/15374410802698396
- Leigh, E., & Clark, D. M. (2016). Cognitive therapy for social anxiety disorder in adolescents: A developmental case series. *Behavioural Cognitive Psychotherapy*, 44, 1-17. doi: 10.1017/S1352465815000715
- Lovett, M. W. (1984). A developmental perspective on reading dysfunction: Accuracy and rate in the subtyping of dyslexic children. *Brain and Language*, 22, 67-91. doi: 10.1016/0093-934X(84)90080-4
- Lyneham, H.J., Abbott, M.J., & Rapee, R.M. (2006). Evaluation of therapist-supported parent-implemented CBT for anxiety disorders in rural children. *Behaviour Research & Therapy*, 44, 1287-1300. doi: 10.1016/j.brat.2005.09.009
- Lyneham, H. J., Abbott, M. J., Wignall, A., & Rapee, R.M. (2003). *The Cool Kids Anxiety Treatment Program* Sydney, Australia: MUARU, Macquarie University
- Lyneham, H. J., Sbrulati, E. S., Abbott, M. J., Rapee, R. M., Hudson, J. L., Tolin, D. F., & Carlson, S. E. (2013). Psychometric properties of the child life interference scale

(CALIS). *Journal of Anxiety Disorders*, 27, 711-719. doi:

10.1016/j.janxdis.2013.09.008

Martinez, R. S., & Semrud-Clikeman, M. (2004). Emotional adjustment and school functioning of young adolescents with multiple versus single learning disabilities.

Journal of Learning Disabilities, 37, 411-420. doi: 10.1177/00222194040370050401

McArthur, G., Eve, P., Jones, K., Banales, E., Kohnen, S., Anandakumar, T., Larsen, L., Marinus, E., Wang, H-C., & Castles, A. (2012). Phonics training for English-speaking poor readers. *Cochrane Database of Systematic Reviews*, 12. doi:

10.1002/14651858.CD009115.pub2

McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015a). Sight word and phonics training in children with dyslexia. *Journal of Learning Disabilities*, 48, 391-407. doi: 10.1177/0022219413504996

McArthur, G., Kohnen, S., Jones, K., Eve, P., Banales, E., Larsen, L., & Castles, A. (2015b). Replicability of sight word training and phonics training in poor readers: A randomised controlled trial. *PeerJ* 3:e922. doi: 10.7717/peerj.922

McArthur, G., Sheehan, Y., Badcock, N. A., Francis, D. A., Wang, H. C., Kohnen, S., Banales, E., Anandakumar, T., Marinus, E., & Castles, A. (2018). Phonics training for English-speaking poor readers (Review). *Cochrane Database of Systematic Reviews*, 11. doi: 10.1002/14651858.CD009115.pub3

McArthur, G., Jones, K., Anandakumar, T., Larsen, L., Castles, A., & Coltheart, M. (2013). A test of everyday reading comprehension (TERC). *Australian Journal of Learning Difficulties*, 18, 35-85. doi: 10.1080/19404158.2013.779588

McArthur, G., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., Banales, E., & Castles, A. (2013). Getting to grips with the heterogeneity of developmental dyslexia. *Cognitive Neuropsychology*, 30, 1-24. doi: 10.1080/02643294.2013.784192

- McGee, R., Williams, S., Share, D. L., Anderson, J., & Silva, P. A. (1986). The relationship between specific reading retardation, general reading backwardness and behavioural problems in a large sample of Dunedin boys: A longitudinal study from five to eleven years. *Journal of Child Psychology and Psychiatry*, 27, 597-610. doi: 10.1111/j.1469-7610.1986.tb00185.x
- Mercer, K. L. (2005). *Relations of self-efficacy to symptoms of depression and anxiety in adolescents with learning disabilities*. (Unpublished doctoral thesis). The University of British Columbia, United States.
- Mifsud, C., & Rapee, R. (2005). Early intervention for childhood anxiety in a school setting: Outcomes for an economically disadvantaged population. *Journal of American Academy for Child and Adolescent Psychiatry*, 44, 996-1004. doi: 10.1097/01.chi.0000173294.13441.87
- Mogg, K., Bradley, B. P., de Bono, J., & Painter, M. (1997). Time course of attentional bias for threat information in non-clinical anxiety. *Behaviour Research and Therapy*, 35, 297-303. doi: 10.1016/S0005-7967(96)00109-X
- Morgan, P. L., & Fuchs, D. (2007). Is there a bidirectional relationship between children's reading skills and reading motivation? *Exceptional Children*, 73, 165-183. doi: 10.1177/001440290707300203
- Morgan, P. L., Farkas, G., Tufis, P. A., & Sperling, R. A. (2008). Are reading and behaviour problems risk factors for each other? *Journal of Learning Disabilities*, 41, 417-436. doi: 10.1177/0022219408321123
- Morgan, P. L., Farkas, F., & Wu, Q. (2012). Do poor readers feel angry, sad, and unpopular? *Scientific Studies of Reading*, 16, 360-381. doi: 10.1080/10888438.2011.570397
- Morris, R. D., Stuebing, K. K., Fletcher, J. M., Shaywitz, S. E., Lyon, G. R., Shankweiler, D. P., et al. (1998). Subtypes of reading disability: Variability around a phonological

- core. *Journal of Educational Psychology*, 90, 347-373. doi: 10.1037/0022-0663.90.3.347
- Moore, D. M., Porter, M. A., Kohnen, S., & Castles, A. (2012). Detecting different types of reading difficulties: A comparison of tests. *Australasian Journal of Special Education*, 36, 112-133. doi: 10.1017/jse.2012.11
- Nation, K., & Snowling, M. (1997). Assessing reading difficulties: The validity and utility of current measures of reading skill. *British Journal of Educational Psychology*, 67, 359-379. doi: 10.1111/j.2044-8279.1997.tb01250.x
- Nation, K., Cocksey, J., Taylor, J. S. H., & Bishop, V. M. (2010). A longitudinal investigation of early reading and language skills in children with poor reading comprehension. *The Journal of Child Psychology and Psychiatry*, 51, 1031-1039. doi: 10.1111/j.1469-7610.2010.02254.x
- Nauta, M. H., Scholing, A., Rapee, R. M., Abbott, M., & Spence, S. H., & Waters, A. (2004). A parent-report measure of children's anxiety: psychometric properties and comparison with child-report in a clinic and normal sample. *Behaviour Research and Therapy*, 42, 813-839. doi: 10.1016/S0005-7967(03)00200-6
- Nelson, J. M., & Gregg, N. (2012). Depression and anxiety among transitioning adolescents and college students with ADHD, dyslexia or comorbid ADHD/dyslexia. *Journal of Attention Disorders*, 16, 244-254. doi: 10.1177/1087054710385783
- Nelson, J. M., Lindstrom, W., & Foels, P. A. (2015). Test anxiety among college students with specific reading disability (Dyslexia): Nonverbal ability and working memory as predictors. *Journal of Learning Disabilities*, 48, 422-432. doi: 10.1177/0022219413507604

Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories.

British Journal of Educational Psychology, 54, 31–39. doi: 10.1111/j.2044-

8279.1984.tb00842.x

Olweus, D. (1983). Low school achievement and aggressive behaviour in adolescent boys. In

D. Magnusson (Ed.), *Human development: An interactional perspective*. San Diego,

CA: Academic Press.

Peterson, R. L., Pennington, B. F., & Olson, R. K. (2013). Subtypes of developmental

dyslexia: Testing the predictions of the dual-route and connectionist frameworks.

Cognition, 126, 20–38. doi: 10.1016/j.cognition.2012.08.007

Pond, D. (1967). Communication disorders in brain-damaged children. *Proceedings of the*

Royal Society of Medicine, 60, 343-348. doi: 10.1177/003591576706000411

Putwain, D. W., Connors, L., & Symes, W. (2010). Do cognitive distortions mediate the test

anxiety-examination performance relationship? *Educational Psychology*, 30, 11-26.

doi: 10.1080/01443410903328866

Rao, P. A., Beidel, D. C., Turner, S. M., Ammerman, R. T., Crosby, L. E., & Sallee, F. R.

(2007). Social anxiety disorder in childhood and adolescence: Descriptive

psychopathology. *Behaviour Research and Therapy*, 45, 1181-1191. doi:

10.1016/j.brat.2006.07.015

Rapee, R. M., Abbott, M.J., & Lyneham, H. J. (2006). Bibliotherapy for Children With

Anxiety Disorders Using Written Materials for Parents: A Randomized Controlled

Trial. *Journal of Consulting and Clinical Psychology*, 74, 436-444. doi:

10.1037/0022-006X.74.3.436

Rapee, R. M., Gaston, J. E., & Abbott, M. J. (2009). Testing the efficacy of theoretically

derived improvements in the treatment of social phobia. *Journal of Consulting and*

Clinical Psychology, 77, 317-327. doi: 10.1037/a0014800

- Riddick, B., Sterling, C., Farmer, M., & Morgan, S. (1999). Self-esteem and anxiety in the educational histories of adult dyslexic students. *Dyslexia*, 5, 227-248. doi: 10.1002/(SICI)1099-0909
- Rouse, H. J., & Wilshire, C. E. (2007). Comparison of phonological and whole-word treatments for two contrasting cases of developmental dyslexia. *Cognitive Neuropsychology*, 24, 817-842. doi: 10.1080/02643290701764207
- Sanson, A., Prior, M., & Smart, D. (1996). Reading disabilities with and without behaviour problems at 7-8 years: Prediction from longitudinal data from infancy to 6 years. *Journal of Child Psychology and Psychiatry*, 37, 529-541. doi: 10.1111/j.1469-7610.1996.tb01439.x
- Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. *Clinical Psychology Review*, 20, 453-478. doi: 10.1016/S0272-7358(99)00037-9
- Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour Research and Therapy*, 36, 545-566. doi: 10.1016/S0005-7967(98)00034-5
- Spence, S. H., Barrett, P. M., & Turner, C. M. (2003). Psychometric properties of the spence children's anxiety scale with young adolescents. *Anxiety Disorders*, 17, 605-625. doi: 10.1016/S0887-6185(02)00236-0
- Shaywitz, S.E., Escobar, M.D., Shaywitz, B.A., Fletcher, J.M., & Makuch, R. (1992). Evidence that dyslexia may represent the lower tail of a normal distribution of reading ability. *New England Journal of Medicine*, 326, 145–150. doi: 10.1056/NEJM199201163260301.
- Sowislo, J. F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*, 139, 213-240. doi: 10.1037/a0028931

- Spurr, J. M., & Stopa, L. (2002). Self-focused attention in social phobia and social anxiety. *Clinical Psychology Review, 22*, 947-975. doi: 10.1016/S0272-7358(02)00107-1
- Storch, E. A., & Masia-Warner, C. (2004). The relationship of peer victimization to social anxiety and loneliness in adolescent females. *Journal of Adolescence, 27*, 351-362. doi: 10.1016/j.adolescence.2004.03.003
- Stuart, M., & Stainthorp, R. (2016). *Reading development and teaching*. London: SAGE.
- Temple, C., & Marshall, J. (1983). A case study of developmental phonological dyslexia. *British Journal of Psychology, 74*, 517-533. doi: 10.1111/j.2044-8295.1983.tb01883.x
- Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of word reading efficiency (TOWRE)*. Austin, TX: ProEd.
- van der Oord, S., Prins, P. J., Oosterlaan, J., & Emmelkamp, P. M. (2008). Efficacy of methylphenidate, psychosocial treatments and their combination in school-aged children with ADHD: A meta-analysis. *Clinical Psychology Review, 28*, 783-800. doi: 10.1016/j.cpr.2007.10.007
- Verduin, T. L., & Kendall, P. C. (2008). Peer perceptions and liking of children with anxiety disorders. *Journal of Abnormal Child Psychology, 36*, 459-469. doi: 10.1007/s10802-007-9192-6
- Walkup J, Albano A, Piacentini J, Birmaher B, Compton S, Sherrill J, et al. (2008). Cognitive behavioural therapy, sertraline, or a combination in childhood anxiety. *The New England Journal of Medicine, 359*, 2753–2766. doi: 10.1056/NEJMoa0804633.
- Wang, H., Nickels, L., & Castles, A. (2015). Orthographic learning in developmental surface and phonological dyslexia. *Cognitive Neuropsychology, 32*, 58-79. doi: 10.1080/02643294.2014.1003536

- Wheldall, K., & McMurtry, S. (2014). Preliminary evidence for the validity of the new Test of Everyday Reading Comprehension. *Australian Journal of Learning Difficulties*, 19, 173-178. doi: 10.1080/19404158.2014.979525
- Willcutt, E. G., & Pennington, B. F. (2000). Psychiatric comorbidity in children and adolescents with reading disability. *Journal of Child Psychology and Psychiatry*, 41, 1039-1048. doi: 10.1111/1469-7610.00691
- Willcutt, E. G. et al. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities*, 46, 500-516. doi: 10.1177/0022219413477476
- Yasutake, D. and Bryan, T. (1995). The influence of affect on the achievement of behaviour of students with learning disabilities. *Journal of Learning Disabilities*, 28, 329–344. doi: 10.1177/002221949502800603
- Zeman, J., Shipman, K., & Suveg, C. (2002). Anger and sadness regulation: Predictions to internalising and externalising symptoms in children. *Journal of Clinical Child and Adolescent Psychology*, 31, 393-398. doi: 10.1207/S15374424JCCP3103_11

APPENDIX A

Advertisement used to recruit children for the study



Researchers at Macquarie University are trying to understand why some children with reading difficulties might feel anxious and worried, or even depressed and sad. If your child experiences problems with reading, and is 8-11 years old, we invite you to complete a literacy and emotional health assessment at Macquarie University. To thank you, you will receive a literacy report with treatment recommendations and \$30 between you for your time. If you would like to participate in this study or find out more information, please contact the research team at anxietyreadingstudy@mq.edu.au.

APPENDIX B

Table B1

Descriptive and inferential statistics for the linking-variable measures for the four groups using child report data

Groups	Row	Statistics	Reading self-concept	Peer relations	Attention	Behaviour
Virtual controls (normative data)	1	M (SD)	3.74 (0.56)	1.60 (1.90)	3.10 (2.40)	1.50 (1.60)
	2	Cutoff	3.18	3.50	5.50	3.10
Experimental (poor readers with anxiety)	3	M	3.03	2.16	5.27	2.16
	4	SD	0.46	2.15	3.05	2.22
	5	SW	.96	.86	.94	.87
	6	%	62.16	27.02	45.94	21.62
Reading control (poor readers without anxiety)	7	M	3.24	2.09	6.00	1.73
	8	SD	0.45	1.30	2.83	1.42
	9	SW	.83	.93	.95	.88
	10	%	27.27	18.18	54.54	9.09
Anxiety control (typical readers with anxiety)	11	M	3.35	2.05	4.68	1.47
	12	SD	0.35	2.25	3.11	1.64
	13	SW	.96	.84	.93	.82
	14	%	31.57	31.57	36.84	10.52
Experimental vs reading control	15	<i>t</i> (df)	-1.28 (46)	0.10 (46)	-0.71 (46)	-0.61 (46)
Experiment vs anxiety control	16	<i>t</i> (df)	-2.63 (54)*	0.18 (54)	0.67 (54)	1.19 (54)

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Grey cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

Table B2

Descriptive and inferential statistics for the reading measures for the four groups

Groups	Row	Statistics	Word accuracy		Reading fluency		Reading Comprehension	
			Phonological recoding		Visual word recognition		Words	Nonwords
			Nonword reading	Nonword spelling	Irregular word reading	Irregular word spelling		
Virtual controls (normative data)	1	M (SD)	0 (1)	10 (3)	0 (1)	0 (1)	100 (15)	100 (15)
	2	Cutoff	-1.00	7	-1.00	-1.00	85.00	85.00
Experimental (poor readers with anxiety)	3	M	-1.38	5.51	-1.25	-0.82	82.92	81.22
	4	SD	0.51	2.21	0.75	0.72	11.67	8.92
	5	SW	.97	.91	.96	.98	.96	.943
	6	%	78.37	81.08	64.86	40.54	59.45	64.86
Reading control (poor readers without anxiety)	7	M	-1.27	4.73	-1.14	-0.92	84.18	80.00
	8	SD	0.90	2.24	1.21	0.59	17.81	11.28
	9	SW	.71	.78	0.89	.96	.81	.97
	10	%	100	81.81	54.54	45.45	45.45	72.72
Anxiety control (typical readers with anxiety)	11	M	0.13	9.32	0.36	0.44	106.47	101.26
	12	SD	0.70	2.85	0.68	1.11	15.15	12.11
	13	SW	.96	.94	.97	.97	.96	.95
	14	%	0.00	15.78	0.00	10.52	5.26	10.52
Experimental vs reading control	15	<i>t</i> (df)	0.81 (46)	1.03 (46)	-0.30 (12.38)	0.41 (46)	-0.22(12.66)	0.37 (46)
Experiment vs anxiety control	16	<i>t</i> (df)	-9.26 (54)*	-5.52 (54)*	-7.84 (54)*	-5.16 (54)*	-6.32 (53)*	-6.45 (54)*

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Shaded cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

Table B3

Descriptive and inferential statistics for the anxiety measures for the four groups

Groups	Row	Statistics	Generalised anxiety	Separation anxiety	Social anxiety (SCAS)	Physical injury fears	Panic / agoraphobia	Obsessive compulsive	Total anxiety (SCAS)	Social anxiety (SPAI)
Virtual controls (normative data)	1	M (SD)	50 (10)	50 (10)	50 (10)	50 (10)	50 (10)	50 (10)	50 (10)	13.74 (8.5)
	2	Cutoff	60	60	60	60	60	60	60	18
Experimental (poor readers with anxiety)	3	M	55.46	58.24	53.08	57.84	53.35	57.84	57.05	19.86
	4	SD	10.46	9.13	10.33	10.62	13.17	12.03	6.89	10.35
	5	SW	.93	.96	.93	.94	.89	.87	.97	.97
	6	%	27.03	45.94	32.43	51.35	27.02	40.54	32.43	59.45
Reading control (poor readers without anxiety)	7	M	46.73	45.45	45.73	43.91	45.73	49.27	43.55	12.27
	8	SD	5.88	6.42	6.26	5.16	4.73	6.59	7.86	7.30
	9	SW	.88	.84	.85	.78	.91	.92	.87	.92
	10	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.27
Anxiety control (typical readers with anxiety)	11	M	52.58	57.11	49.79	58.68	52.58	53.53	54.79	17.68
	12	SD	7.95	9.63	9.49	8.68	9.27	8.81	7.40	9.75
	13	SW	.94	.96	.88	.90	.92	.91	.92	.97
	14	%	15.78	47.36	15.78	63.15	15.78	31.57	15.78	52.63
Experimental vs reading control	15	<i>t</i> (df)	2.63 (46)*	4.32 (46)*	2.23 (46)*	4.18 (46)*	4.02 (42.73)*	2.25 (46)*	5.52 (46)*	2.26 (46)*
Experiment vs anxiety control	16	<i>t</i> (df)	1.05 (54)	0.43 (54)	1.16 (54)	-0.29 (54)	0.23 (54)	1.37 (54)	1.13 (54)	0.76 (54)

Note. SW = Shapiro-Wilk Score; % = per cent of children in the group whose score fell beyond the cut-off score; * $p < .05$. Grey cells indicate that the statistic met the criterion for impairment. Bolded SW values indicate that the distribution of scores differed statistically from a normal distribution.

CHAPTER 4

The Development of “Cool Reading”: A Combined Reading and Anxiety Treatment for Children

Author’s statement: DF, GM, and JH contributed to the design of the program. HL provided input for the development of the anxiety component of Cool Reading. DF, GM, and JH revised and provided feedback on the manuscript.

ABSTRACT

We have established that some poor readers are at risk for anxiety. However, to the best of our knowledge, there are no integrated reading and anxiety treatments for children with concomitant reading and anxiety problems. In this chapter, we outline the development of such a treatment which comprised a suite of evidence-based reading treatment components and anxiety treatment components. We provide evidence supporting the selection of these components, as well as the clinical tools used to deliver these treatment components. This new integrated reading and anxiety treatment, which we named “Cool Reading”, represents a step towards improving reading and anxiety outcomes for children with these difficulties.

Keywords: poor reading; anxiety; integrated reading and anxiety treatment.

INTRODUCTION

Thus far, this thesis has sought to better understand the association between poor reading and anxiety by conducting a systematic review and meta-analysis (see Chapter 2), and a profiling study that aimed to identify the reading, anxiety, and “linking variables” associated with concomitant reading and anxiety problems in children (see Chapter 3). The systematic review and meta-analysis revealed a statistically significant moderate association between poor reading and anxiety, which suggested that some poor readers may be especially at risk for clinically elevated anxiety. The profiling study revealed that poor readers with anxiety have multiple word reading accuracy problems and social anxiety, and hence need concomitant reading and anxiety treatment.

To date, co-occurring problems with reading and anxiety have been treated separately. To our knowledge, just one intervention study has been conducted with children with concomitant reading and anxiety problems, and this study only administered reading treatment (i.e., there was no treatment for anxiety; Grills, Fletcher, Vaughn, Barth, Denton, & Stuebing, 2014). The absence of an evidence-based integrated reading and anxiety treatment for children is concerning because poor reading and anxiety are independently associated with poor academic achievement (Mychailyszyn, Mendez, & Kendall, 2010; Van Ameringen, Mancini, & Farvolden, 2003), victimisation and bullying (Boyes, Leitzo, Claessen, Badcock, & Nayton, 2016; Luciano & Savage, 2007; Settapani & Kendall, 2013; Verduin & Kendall, 2008), behaviour problems (Bittner, Egger, Erkanli, Costello, Foley, & Angold, 2007), poor educational and employment outcomes (Essau, Lewinsohn, Olaya, & Seeley, 2014; Smart, Youssef, Sanson, Prior, Toumbourou, & Olsson, 2017), and severe emotional health problems in adulthood (Costello, Angold, & Keeler, 1999). Thus, there are numerous reasons why we need an effective treatment for concomitant reading and anxiety problems in children. We therefore developed an integrated reading and anxiety treatment for children,

which we called "Cool Reading". The aim of the current chapter is to describe the structure, the scientific evidence, the clinical tools, and the procedures supporting Cool Reading.

THE STRUCTURE OF COOL READING

Cool Reading includes two types of evidence-based treatment components: reading treatment and anxiety treatment. The reading treatment components focus on three levels of reading: word reading accuracy, reading fluency, and reading comprehension. These treatment components are arranged in a hierarchy that aligns with the acquisition of reading skills (Gibson, 1965; Gough, 1972; Gough & Tunmer, 1986; Hoover & Gough, 1990; Perfetti & Hogaboam, 1975; Shinn, Good, Knutson, Tilly, & Collins, 1992). Specifically, when children are first taught to read, instruction focuses on building their word accuracy skills via phonological recoding and visual word recognition (Adams, 1990; Simmons & Kameenui, 1998). As their word accuracy improves, more emphasis is placed on their reading fluency (Kunh & Stahl, 2003; LaBerge & Samuels, 1974). As reading accuracy and fluency continue to develop, reading instruction starts to focus on comprehension (Golinkoff, 1975; Jenkins, Fuchs, van den Broek, Epsin, & Deno, 2003). Thus, reading accuracy is a foundational reading skill for both reading fluency and comprehension, and reading accuracy and fluency are foundation skills for reading comprehension (Golinkoff, 1975; LaBerge & Samuels, 1974; Perfetti & Hogaboam, 1975; Perfetti, 1985, 1992). According to this hierarchy, in Cool Reading, if a child has an impairment in word accuracy, reading fluency, and reading comprehension, reading treatment would start with word accuracy before moving to reading fluency and then reading comprehension. Only if a child has a highly-specific impairment in reading fluency (Lovett, 1984; Morris et al., 1998) or reading comprehension (Nation & Snowling, 1997; Oakhill, 1994) would reading treatment focus solely on these impairments.

The anxiety treatment components of Cool Reading are arranged in a hierarchy of a different type. It comprises core treatment components that treat anxiety symptoms that are

common to all types of anxiety (e.g., Psychoeducation, Controlled Breathing, Cognitive Restructuring, Gradual Exposure), and it includes additional specific treatment components (e.g., Social Skills and Confidence Training, Dealing with Bullying Strategies) that treat symptoms that are specific to certain types of anxiety (e.g., a social skills deficit associated with social anxiety). In Cool Reading, all children are administered all core treatment components. Children are only administered a specific anxiety component (e.g., Social Skills and Confidence Training) if they have the relevant type of anxiety (e.g., social anxiety) and specific skill deficit (e.g., social skills deficit).

THE EVIDENCE AND CLINICAL TOOLS SUPPORTING COOL READING

Table 1 below outlines the reading and anxiety treatment components that comprise Cool Reading, along with the clinical tools that we used to deliver each component. In the sections below, we provide a brief review of the evidence base for each Cool Reading treatment component before describing the clinical tool that we used to deliver that treatment.

Table 1

Cool Reading treatment components for reading and anxiety (column 1) with the clinical tools we used to deliver each treatment component (column 2)

Treatment components	Clinical tools
Reading	
Word accuracy	
Phonics	MURC Reading Gap intervention program MURC Spelling Gap intervention program
Sight words	MURC Sight Words intervention program (reading) MURC Sight Words intervention program (spelling)
Text reading	MURC Text Reading intervention program
Reading fluency	MURC Reading Fluency intervention program
Reading comprehension	Visualising and Verbalising
Anxiety	
Core	
Psychoeducation	Cool Kids Psychoeducation (modified)
Controlled Breathing	Cool Kids Cool Breathing (modified)
Cognitive Restructuring	Cool Kids Detective Thinking (modified)
Gradual Exposure	Cool Kids Stepladders (modified)
Child Management	Cool Kids Child Management Strategies for Parents (modified)
Specific	
Social Skills and Confidence	Cool Kids Social Skills and Confidence
Structured Problem-Solving	Cool Kids Structured Problem-Solving
Dealing with Bullying	Cool Kids Dealing with Bullying
Progressive Muscle Relaxation	Cool Kids Progressive Muscle Relaxation

Note. MURC = Macquarie University Reading Clinic

Word Accuracy

Evidence

There are two widely used treatments for word accuracy problems in children. The most common and effective reading treatment tested to date is "phonics training", which teaches children the phonological recoding skills required to read words accurately using grapheme-to-phoneme (GPC) rules. The effect of specific phonics training in poor readers has been examined in at least four systematic reviews with meta-analyses. In an early review, Ehri, Nunes, Stahl, and Willows (2001) reported that phonics training had a moderate effect on word reading accuracy (Cohen's $d = 0.67$), and nonword reading accuracy ($d = 0.60$). In a later review, Galuschka and colleagues conducted a systematic review and meta-analysis of 49 randomised controlled trials of reading interventions. Phonics training was the most frequently administered reading intervention for children and adolescents, which showed a small yet significant effect of phonics training on overall reading performance ($g = 0.32$; Galuschka, Ise, Krick, & Schulte-Korne, 2014). In 2012, McArthur and colleagues (2012) found that specific phonics training significantly improved nonword reading accuracy ($d = 0.76$), word reading accuracy ($d = 0.51$), and GPC knowledge ($d = 0.35$) for English-speaking poor readers. A recent update of this review showed that phonics training has statistically significant moderate-to-large training effects on nonword reading accuracy ($d = 0.67$), word reading accuracy ($d = 0.51$), and GPC knowledge ($d = 0.35$) in poor readers (McArthur et al., 2018). Considered together, the results of these reviews provide firm evidence that phonics training improves word reading accuracy and GPC knowledge for children with reading difficulties.

Another reading treatment for children with poor word accuracy is visual word recognition training, which is more commonly known as "sight-word training". Sight-word training teaches children to recognise whole regular and irregular words from memory. Sight-

word reading is particularly important for English readers because approximately one-third of English words are irregular (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Unlike regular words, irregular words cannot be read accurately using phonological recoding skills alone, hence irregular words need to be learned at least in part via sight-word training. Irregular words can therefore provide more specific insights than regular words into the effects of sight-word treatment because regular words can be learned accurately via phonological recoding as well as visual word recognition.

While numerous treatment studies have administered sight-word training to poor readers, only a handful have used irregular words to assess sight-word treatment effects in poor readers. Three were interventional case series studies that used irregular word reading treatment programs in children with specific irregular word deficits (Broom & Doctor, 1995; Brunsdon, Coltheart, & Nickels, 2002; Rouse & Wilshire 2007). Two of these case studies found that irregular word reading and/or spelling training significantly improved irregular word reading in children with specific irregular-word reading deficits (Broom & Doctor, 1995; Brunsdon et al., 2002). More recently, Rouse and Wilshire conducted an interventional case series study with two poor readers – one with a specific impairment in nonword reading and another with a specific impairment in irregular word reading. Children received GPC treatment and irregular word reading training. Both children showed improvements for GPC knowledge, while the child with a specific irregular word deficit showed improvement for regular and irregular words after treatment.

Two randomised controlled trials have also used irregular words to assess the effect of sight-word treatment in poor readers. McArthur and colleagues (2015a) administered irregular word reading training to a group of 104 poor readers with mixed reading impairments for 30 minutes per day, 5 days per week, for 8 weeks. The treatment comprised flashcard training and a customised computer game to teach children irregular words.

Compared to an untrained double-baseline period, this treatment significantly improved outcomes for both trained and untrained irregular word reading accuracy. In a replication of this study with 85 poor readers, McArthur and colleagues (2015b) found that training irregular words significantly improved trained irregular word reading accuracy ($d = 0.87$) as well as word reading fluency ($d = 1.39$). Combined, these results suggest that sight-word treatment improves trained irregular word reading accuracy and sight-word reading skills for children with poor reading.

Clinical tools

Phonics treatment. We used two clinical tools to train phonics-related skills in Cool Reading. One is the Macquarie University Reading Clinic (MURC) Reading Gap intervention program which trains phonics-related reading problems (Kohnen & Banales, 2015a). This treatment makes a distinction between target GPC errors (e.g., reading “deeg” as “deg” when the target GPC is EE), non-target GPC errors (e.g., reading “deeg” as “beeg”), letter position errors (e.g., reading “deeg” as “geed”), segmentation errors (e.g., segmenting “deeg” as D E G), and phoneme blending errors (e.g., blending D E E G into “deg”). This program directly trains target GPC errors in the context of words and nonwords. The clinician presents at least 10 words and/or nonwords to the child. These words and nonwords contain a target GPC. The child reads the words and nonwords aloud. If the child makes a target GPC error, then the clinician prompts the child with the correct GPC and the child attempts the word or nonword again. If the child makes a non-target GPC error, letter position error, segmentation error, or blending error then the clinician models the correct response that the child then repeats. Once the child performs accurately on the target GPC over multiple sessions, the clinician considers the target GPC to be mastered. Typically, training focuses on two unknown GPC rules per lesson. The time spent on each GPC varies between children,

but typically ranges from one to four treatment sessions. However, more treatment may be required.

It is noteworthy that the MURC Reading Gap intervention program provides “direct” training for GPC knowledge because the child repeatedly practices applying GPCs to words and nonwords. In addition, this training includes “indirect” training for non-target GPC, letter position encoding, and phoneme segmentation and blending (i.e., phonological processing) errors via corrective feedback on these errors. However, children are not provided repeated instruction specifically for these latter skills in the MURC Reading Gap intervention program. If a child shows pervasive difficulties with segmentation or blending, then they would receive the MURC Blending intervention program or the MURC Segmentation intervention program which target phoneme blending and segmentation difficulties respectively (Kohnen & Banales, 2015d; 2015e). If children show pervasive difficulties with letter position encoding, they would be taught specific strategies for letter position encoding.

The second clinical tool we selected is the MURC Spelling Gap intervention program which treats phonics-related spelling problems (Kohnen & Banales, 2015b). As with the reading phonics program, this program teaches children target phoneme-to-grapheme correspondence (PGC) rules that they have not yet acquired. Children are taught target PGC rules in the context of words and nonwords with immediate corrective feedback from the clinician. This treatment again makes a distinction between target PGC errors (e.g., spelling “squip” as SKWIP when the target PGC is QU), non-target PGC errors (e.g., spelling “squip” as SQUEP), phoneme segmentation errors (e.g., segmenting “squip” as S K I P), phoneme blending errors (e.g., blending S Q U I P as “skip”), and nonword repetition errors (e.g., repeating the nonword SQUIP as “skip”). This program directly trains target PGC errors in the context of words and nonwords. The clinician presents at least 10 words and/or nonwords to the child. These words and nonwords contain the target PGC. The child repeats the word

or nonword, segments the sounds, and writes the word. If the child makes a target PGC error, then the clinician prompts the child with the correct PGC. If the child makes a non-target PGC error, segmentation error, blending error, or nonword repetition error then the clinician models the correct response, the child repeats the correct response (for segmentation and blending), and writes the correct spelling. Typically, training focuses on two unknown PGC rules per lesson. The time spent on each PGC varies between children, but typically ranges from one to four treatment sessions. However, more treatment may be required.

The MURC Spelling Gap intervention program provides direct training for PGC knowledge because the child repeatedly practices applying PGCs to words and nonwords. In addition, this training includes indirect training for non-target PGC errors, phoneme segmentation or blending errors (i.e., phonological processing), and nonword repetition errors (i.e., phonological output) because the child is provided corrective feedback for these errors but does not receive repeated explicit treatment in these skills. As above, if a child shows pervasive difficulties with phoneme segmentation or blending, then they would receive the MURC Blending intervention program and/or the MURC Segmentation intervention program, which target phoneme blending and segmentation difficulties, respectively (Kohnen & Banales, 2015d; 2015e).

Sight word training. We used two clinical tools to train sight word skills in Cool Reading. One is the MURC Sight Words intervention program which focuses on training the reading of unknown sight words (Kohnen & Banales, 2015c). These words are selected from a list of frequently read sight words that were compiled by researchers at the MURC. Children are taught to read these new sight words through flashcard training. The sight word is printed on a flashcard and the child reads the word aloud. Children may make word errors (e.g., reading COULD as CLOWN), or letter position errors (e.g., reading COULD as CLOUD). For all errors, the clinician models the correct response and the child repeats the

word. The child also practices writing and spelling the sight word. Treatment typically includes four to eight sight words per lesson and the child practices each word once per session for three sessions. The sight word is considered learned when the child reads the sight word correctly across at least three consecutive sessions. However, more treatment may be required to master each sight word.

The MURC Sight Words intervention program provides direct training for sight word reading since the child is learning to recognise whole written words by sight. Hence, sight word treatment has a direct effect on the orthographic lexicon (Ehri, 2013). This treatment also includes indirect training for letter position encoding as children are provided with corrective feedback for letter position errors but are not provided with specific or repeated instruction in letter position processing per se. It is noteworthy that MURC Reading Sight Words intervention program does not train the meanings of sight words (i.e., semantic knowledge) or pronunciation of spoken words (i.e., the phonological lexicon or phonological output).

The second clinical tool we used to train sight words was the MURC Sight Words intervention program which focuses on training the spelling of unknown sight words (Kohnen & Banales, 2015c). These words are selected from a list of frequently spelled sight words. Children are taught to spell these new sight words by writing the sight word, remembering the spelling, and spelling the sight word aloud. Children may make word errors (e.g., spelling WAS as WOZ) or letter position errors (e.g., spelling WAS as SAW). For all errors, the clinician provides the correct spelling for the sight word and the child copies the word. Typically, training focuses on four to eight sight words per lesson. Children practice spelling the sight words over at least three consecutive sessions. A sight word is considered learned when the child spells the sight word correctly over multiple sessions. As with the

reading sight words, children practice spelling sight words over three sessions, but more training may be required to master the spelling of some words.

The MURC Sight Words intervention program provides direct training for sight word spelling and irregular word spelling since the child is learning to spell whole written words by sight. Hence, sight word treatment has a direct effect on the orthographic lexicon. This treatment also includes indirect training for letter position encoding as children are provided with corrective feedback for letter position errors but are not provided with specific or repeated instruction in letter position processing as such. As mentioned above for reading, it is noteworthy that MURC Sight Words intervention program for spelling does not train the meanings of sight words (i.e., semantic knowledge) or pronunciation of spoken words (i.e., the phonological lexicon or phonological output).

Text accuracy training. At the end of each session of the MURC Reading Gap intervention program, the MURC Spelling Gap intervention program, and the MURC Sight Words intervention program, children are asked to read a book that is appropriate for their reading level. If children make a GPC error on a regular word (e.g., reads “coop” as “cop”) then the clinician prompts the child with the correct GPC rule (e.g., this word has OO, the OO letters make the /oo/ sound; let’s look again; this word says COOP). If a child makes an error on an irregular word (e.g., DAUGHTER), then the clinician provides the child with the correct pronunciation of the word. This text reading training provides children direct instruction in text reading accuracy. It also provides indirect instruction for GPC knowledge and sight word reading through the corrective feedback provided to children.

Reading fluency

Evidence

A treatment that has received considerable empirical investigation for reading aloud fluency (herein referred to as “reading fluency”) is repeated reading (for recent review see

Lee & Yoon, 2017). Repeated reading requires children to read the same passage of text to achieve a fluency benchmark. Research suggests that repeated reading significantly improves reading fluency, reading accuracy, and reading comprehension for poor readers and typical readers (Chafouleas, Martens, Dobson, Weinstein, & Gardner, 2004). There have been at least three meta-analyses on the specific effects of repeated reading for poor readers (Lee & Yoon, 2017; National Reading Panel, 2000; Therrien, 2004). The earliest review, which included 98 studies, found that repeated reading had a moderate effect on reading achievement outcomes for poor and typical readers, but the effect was greater for typical readers ($d = 0.41$; National Reading Panel, 2000). In a more recent meta-analysis, the data of 16 studies revealed that repeated reading is an effective treatment to improve reading fluency for trained fluency passages ($d = 0.75$) and trained reading comprehension tasks ($d = 0.73$), as well as untrained fluency passages ($d = 0.79$) and untrained reading comprehension tasks ($d = 0.41$) in children and adolescents with learning disabilities, including poor readers (Therrien, 2004). In the most recent review, the results of 34 studies suggested that repeated reading has a positive effect on reading fluency for poor readers (Hedges $g = 1.41$; Lee & Yoon, 2017). Considered together, this evidence suggests that repeated reading is an effective treatment to improve reading fluency outcomes in poor readers.

Clinical tool

For reading fluency, we used the MURC Reading Fluency intervention program, which asks children to read passages of text quickly and accurately. The clinician provides the child with immediate feedback on any reading errors. If a child does not know an irregular word or attempts to sound out an irregular word, the clinician provides the correct pronunciation of the irregular word. If the child makes an error on a regular word, then the clinician prompts the child to sound out the word using their GPC knowledge. The clinician also provides the child with GPC rules that they do not know. The child is provided with

fluency and accuracy feedback after they read the passage of text (e.g., "You read that passage in one minute and you made five errors; let's see if we can do it a bit better next time"). They practice reading the same text four times in a session. They moved onto the next passage when completed reading the passage within allocated timeframe. The MURC Reading Fluency intervention program directly trains word reading fluency. This training also includes indirect training for irregular word reading accuracy and GPC knowledge as children are provided with corrective feedback for these errors.

Reading comprehension

Evidence

Although reading comprehension is the ultimate goal of reading, there are surprisingly few well-controlled studies that evaluate the efficacy of reading comprehension treatment in poor readers. Our reading comprehension treatment of choice is mental imagery, which teaches children to create a visual story of the text in their mind (Bell, 1986; Duff & Clarke, 2011; Johnson-Glenberg, 2000; Oakhill & Patel, 1991). This imagery is thought to improve children's understanding of the text. Research on imagery training (e.g., representational drawings) has significantly improved poor readers' reading comprehension compared to control treatments (e.g., reading and answering questions; Oakhill & Patel, 1991). In a more recent study, Johnson-Glenberg (2000) evaluated the efficacy of the widely administered Visualising and Verbalising programme (V/V; Bell, 1986), which teaches children to create mental images and use verbal summaries. The study compared groups of children who received V/V treatment, reciprocal teaching (e.g., learning to summarise text, make predictions, generate questions, and clarify information; Palincsar & Brown, 1984), or no training. The results showed that children in the V/V and reciprocal teaching groups improved significantly on measures of reading comprehension and reading skills compared to the group of children with no training. The V/V group made significantly greater

improvements on inferencing than the no training group. The reciprocal teaching group made significantly greater improvements for generating and answering explicit questions compared to the no training group. These findings suggest that mental imagery can improve reading comprehension outcomes, particularly for inferencing, when administered to children with poor reading comprehension.

Clinical tool

The clinical tool that we selected for reading comprehension was the V/V programme (Bell, 1986). This structured programme teaches children comprehension skills, expressive language skills, and descriptive and critical thinking skills to help children understand texts as they read. At the start of the programme the clinician “sets the climate” to draw similarities between creating and verbalising mental images. Once this has been mastered, the clinician introduces “word level imagery”. In this task, children learn to describe a picture that the clinician cannot see. Children are also taught to use structure words to scaffold their descriptions (e.g., size, shape, colour, movement perspective). Following this, the clinician introduces “personal/known noun imaging”. For this task, children describe nouns without pictures (e.g., describe a dog) and are encouraged to use structure words to describe the noun. Once personal/known noun imaging has been achieved, the clinician introduces “sentence level imagery”, which requires children to describe sentences that include a known noun (e.g., The dog chased the ball). Next, the clinician introduces “sentence by sentence imagery”. This requires children to describe sentences that increase in complexity and length and learn to summarise. In the final task, the clinician introduces “paragraph level imagery”, whereby children learn to visualise, describe, and summarise complex passages of text. Considered together, at the end of the V/V children have learned and practiced reading comprehension skills, expressive language skills, and descriptive and critical thinking skills.

Anxiety

Evidence

Cognitive behaviour therapy (CBT) is the most effective, and hence gold standard, psychological treatment for childhood anxiety (Kendall, 2000). The goal of CBT is to modify children's thoughts, feelings, and behaviour through core treatment components (e.g., psychoeducation, cognitive restructuring, gradual exposure) and specific skills training components (e.g., social skills, problem solving; see for review Albano & Kendall, 2002; Rapee, Wignall, Hudson, & Schniering, 2000).

Numerous reviews have evaluated the efficacy of CBT. Compton and colleagues (2002) showed that CBT had small, moderate, and large effects on self-reported anxiety symptoms (Cohen's $d = 0.21$ to 2.53), parent-reported anxiety symptoms ($d = 0.15$ to 3.98), and clinician reported anxiety symptoms ($d = 0.38$ to 1.46) for anxious children compared to wait-list control participants. Ishikawa and colleagues reviewed 20 randomised controlled trials and discovered that CBT had a moderate and significant effect on anxiety symptoms for anxious children and adolescents compared to control participants ($d = 0.61$; Ishikawa, Okajima, Matsuoka, & Sakano, 2007).

In terms of anxiety disorders, Cartwright-Hatton and colleagues (2004) evaluated 10 randomised controlled trials and discovered that CBT resulted in a significantly higher post-treatment remission rate (56.5%) in children and adolescents with anxiety compared to no-treatment anxiety control groups (34.8%; Cartwright-Hatton, Roberts, Chitsanesean, Fothergill, & Harrington, 2004). A more recent review discovered that 12 weeks of CBT resulted in a post-treatment remission rate of 20% to 46% for anxious children (Ginsburg et al., 2011). The most recent Cochrane Review of CBT treatments for child and adolescent anxiety also suggests that CBT effectively lowers anxiety for anxious children and adolescents, and is as effective as non-CBT active control treatments and medication (James,

James, Cowdrey, Soler, & Choke, 2013). Considered together, these reviews consistently show that CBT significantly improves treatment outcomes for children with anxiety.

One of the most widely-used and effective CBT anxiety treatments used in Australia for child anxiety is the Cool Kids for Anxiety programme (herein “Cool Kids”; Lyneham, Abbott, Wignall, & Rapee, 2003). Cool Kids is a manualised (i.e., written manual which encourages adherence to treatment integrity and fidelity) CBT treatment that is designed for children aged 7-to-17 years. The programme includes 10 sessions in total. The first eight sessions are scheduled weekly. The last two sessions are scheduled fortnightly. Each session is 60- to 90-minutes long. Sessions can be completed one-on-one or in a group with other children. Parents attend the first and last 10 minutes (approximately) of each session.

The core components of Cool Kids include Psychoeducation (e.g., teaching children and parents about anxiety), Cognitive Restructuring (e.g., changing unhelpful thoughts), Graded Exposure (e.g., creating new learning experiences that allow children to incorporate real world evidence to change their anxiety), and Child Management Strategies for Parents (e.g., teaching parents about their own behaviours that may be maintaining anxiety or allowing avoidance). The specific components include Progressive Muscle Relaxation (e.g., teaching children to gradually relax muscles throughout their body), Social Skills and Confidence Training (e.g., role playing different social situations with the clinician), Problem Solving (e.g., learning steps to identify problems and brainstorm possible solutions), and Dealing with Bullying (e.g., learning and practicing some “clever comebacks” to respond to bullies in the playground). These core and specific treatment components of Cool Kids teach children strategies to independently manage their anxiety.

Numerous randomised controlled trials support the efficacy of Cool Kids (e.g., Hudson, Rapee, Deveney, Schniering, Lyneham, & Bovopoulos, 2009; Lyneham, Abbott, & Rapee, 2006; Mifsud & Rapee, 2005; Rapee, Abbott, & Lyneham, 2006). For example,

Hudson and colleagues (2009) conducted a randomised controlled trial to examine if Cool Kids was more effective than a non-specific control condition that provided group support to children and parents. The results showed that remission of primary anxiety disorders was significantly greater for Cool Kids (68.6%) compared to the control treatment (45.5%).

Similar remission rates have been reported in other randomised controlled trials – including those where the mode of delivery has differed. Chavira and colleagues (2014) conducted a study in which parents and children received 10 active treatment sessions that were delivered by a clinician (i.e., clinician delivered) or delivered by the parent with clinician support either over the telephone or face-to-face (i.e., clinician supported). Similar remission rates were reported for all anxiety disorders for both the clinician delivered (75%) and clinician supported treatments (54%; Chavira, Drahota, Garland, Roesch, Garcia, & Stein, 2014).

Mifsud and Rapee (2005) also evaluated a modified version of Cool Kids for schools.

Children with anxiety were selected based on elevated anxiety symptoms, and schools were assigned to receive either Cool Kids treatment or a waitlist control. For the schools receiving Cool Kids, children received small-group intervention and parents received two information sessions. The results showed that children who received Cool Kids reported a significant reduction in anxiety symptoms compared to the waitlist control children. Considered together, this evidence suggests that the CBT-based Cool Kids for Anxiety programme is a reliably effective treatment of childhood anxiety.

Clinical tools

Psychoeducation. Psychoeducation is a core component of Cool Kids which aims to educate parents and children about anxiety symptoms and disorders and orient them to the cognitive behavioural approach of the programme. It does this through discussions and workbook activities that focus on (1) normalising anxiety; (2) learning how anxiety impacts the body (e.g., physical symptoms), thoughts (e.g., unrealistic thoughts), and behaviour (e.g.,

avoidance); (3) the causes of anxiety; and (4) how Cool Kids can reduce anxiety. Children learn to evaluate the intensity of their anxiety using a worry rating scale and completing activity sheets to link their thoughts and feelings. In Cool Reading, we adapted the Cool Kids Psychoeducation activities to suit poor readers by using cartoon videos to introduce the activities described above. We also removed any written content from the child workbook and created simplified activity sheets (e.g., see Figure 1 for an excerpt of the developing calm and worried thoughts worksheet).

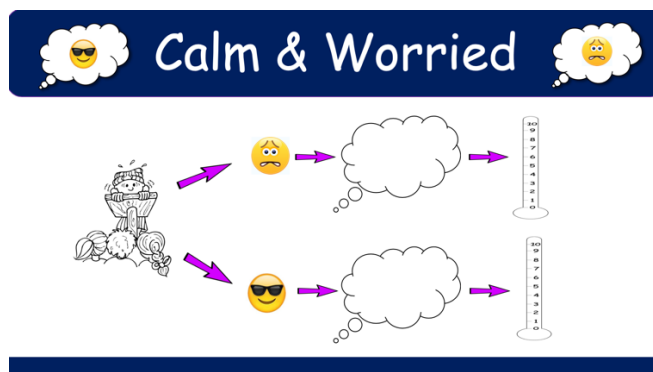


Figure 1. Simplified in-session activity

Controlled Breathing. Controlled Breathing is a specific component of Cool Kids which aims to teach children to calm their physiological response and tolerate feelings of distress when anxious. Cool Kids teaches Controlled Breathing through in-session practice with the clinician. In Cool Reading, we adapted the Cool Kids Controlled Breathing for inclusion as a core component. We introduced Controlled Breathing using cartoon videos, we practiced breathing with the clinician during sessions, and we created a visual cue to remind children to practice breathing (see Figure 2 for an excerpt of the breathing visual cue). We decided to include breathing as a core component to reduce any distress that children may experience before commencing reading treatment. Hence, children practiced Controlled Breathing immediately before reading treatment at the start of each session.

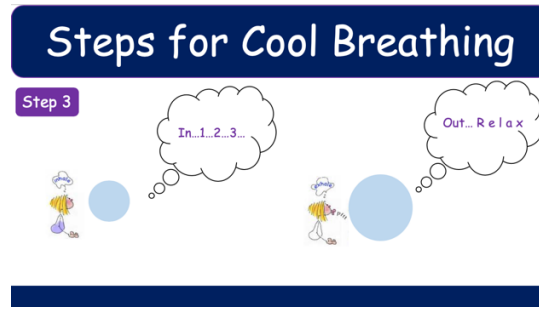


Figure 2. The Cool Reading visual cue for Controlled Breathing in the child workbook

Cognitive Restructuring. Cognitive Restructuring is a core component of Cool Kids which aims to modify children’s unrealistic thoughts, expectations, and beliefs about anxiety-provoking situations. Cool Kids teaches Cognitive Restructuring using “Detective Thinking” worksheets where the child learns to (1) identify thoughts and events, (2) evaluate evidence to change an unrealistic thought to a realistic thought, (3) use the realistic thought, and (4) add evidence from experience to the realistic thought. To record this process, in Cool Kids, children complete Detective Thinking worksheets where they are required to read and write. Children also complete independent Detective Thinking worksheets for homework.

In Cool Reading, Cognitive Restructuring was included as a core component. We adapted the Cool Kids Cognitive Restructuring activities to suit poor readers by using cartoon videos to teach the process of Detective Thinking. We simplified the Detective Thinking worksheets and used pictures to teach children the steps of Detective Thinking (see Figures 3 and 4 for excerpts of the Detective Thinking activity sheets). We also simplified the terminology by changing “realistic and unrealistic” thoughts to “calm and worried” thoughts, and reduced the writing demands on the child by inviting parents to record their child’s response or allowing children to draw pictures.

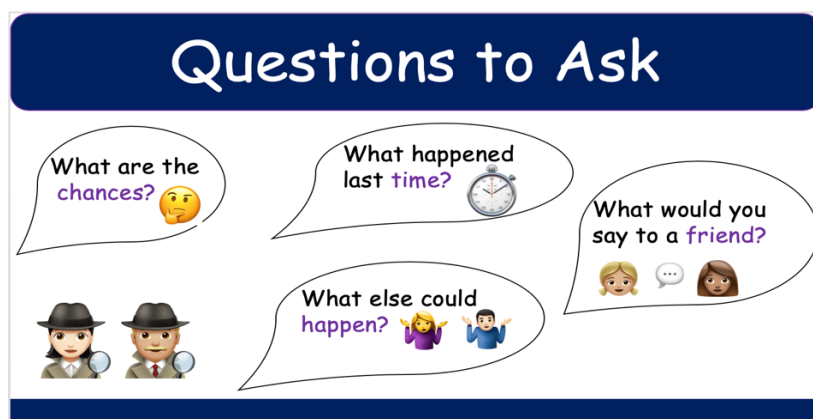


Figure 3. Visual cue for the Detective Thinking questions

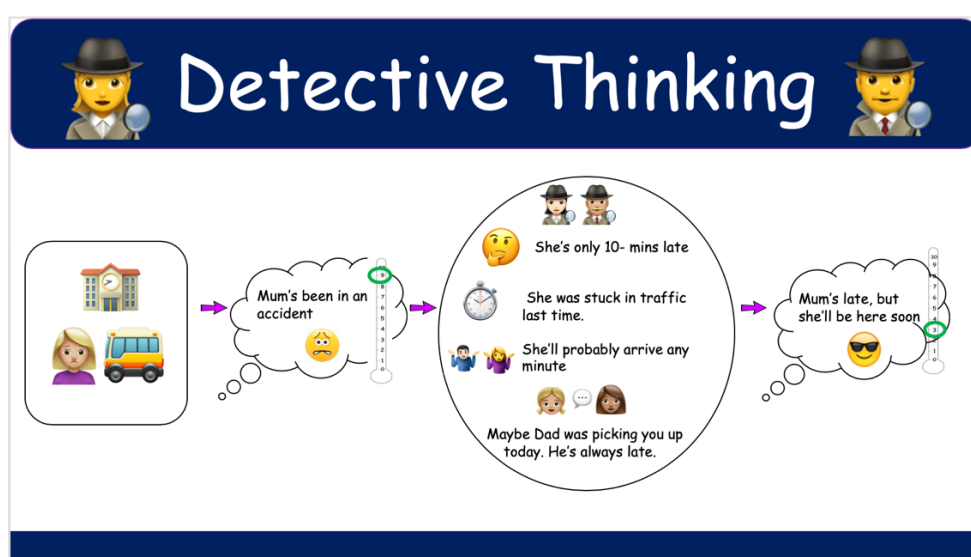


Figure 4. A worked example of the modified Detective Thinking worksheet

Gradual Exposure. Gradual Exposure is a core component of Cool Kids which aims to reduce anxiety by encouraging children to repeatedly and gradually face their fears to encourage new learning. It does this through discussion with the clinician and completing activities in the child workbook. The activities focus on (1) creating lists of fears; (2) creating and writing Gradual Exposure steps in the child workbook; and (3) practicing and writing Gradual Exposure attempts in the child workbook.

In Cool Reading, we included the Cool Kids Gradual Exposures as a core component. We adapted the Cool Kids activities to suit poor readers by using cartoon videos to introduce the rationale for gradual exposure. We removed any written content from the child workbook,

and reduced the writing demands of the child by asking the clinician or parent to write the child's responses, or asking the child to draw pictures (e.g., see Figure 5 for excerpts of the Gradual Exposure worksheets). We also delayed exposure until Session 13 (week 5) to provide children with the opportunity to improve reading skills, confidence, and coping strategies to reduce any potential negative reading related exposures.

My Stepladder

My goal

My reward

Step 5 Step 10

Step 4 Step 9

Step 3 Step 8

Step 2 Step 7

Step 1 Step 6

In-Session Steps

What will I do?

What skills will I practice?

At Start

At end

What did I learn?

Fighting Fear by Facing Fear

Step Go to every shop in the food court and ask how much \$ for a bottle of water

What do I think will happen? They will laugh at me

What did I learn? They answered my question and didn't laugh. But I need to talk loud so they can hear me

Reward 1-hour screen time Step If I did it again...

Figure 5. Example worksheets in the child workbook for Gradual Exposure tasks

Child Management Strategies for Parents. Child Management Strategies for Parents is a core component of Cool Kids which aims to target parent's response to children. It does this by providing information to parents in a parent manual to help them understand the behaviours that may maintain their child's anxiety (e.g., learning how to identify parenting behaviours that may encourage anxiety or avoidance). The clinician reinforces this content through discussions with the parent without the child present. In Cool Reading, we included the Cool Kids Child Management Strategies for Parents as a core component. We did not modify the Cool Kids information that parents received, but we did modify the frequency in which parents attended sessions (e.g., typically the last 10-15 minutes of each session).

Social Skills and Confidence. Social Skills and Confidence is a specific component of Cool Kids which aims to teach children basic social skills. It does this through role play activities with the clinician. Social Skills and Confidence is selected when the child shows difficulties in the delivery of social skills (e.g., speaks too softly), passive behaviour (e.g., extremely shy), or aggressive behaviour (e.g., behavioural outbursts). In Cool Reading, we also included the Cool Kids Social Skills and Confidence as a specific component. We did not make any modifications to this treatment

Structured Problem Solving. Cool Kids also includes Structured Problem Solving as a specific component. This component aims to teach children to identify problems, brainstorm solutions, and select and execute a solution. Structured Problem Solving is appropriate for children who seek excessive reassurance (e.g., repeatedly ask parents questions associated with anxiety), or rely excessively on parents or friends to solve problems. In Cool Reading, we included Cool Kids Structured Problem Solving as a specific component. We did not modify this treatment component.

Dealing with Bullying. Dealing with Bullying is another specific Cool Kids component. In this component, children learn strategies to help them cope with bullies. Dealing with Bullying should be selected if children are being bullied and the bullying is contributing to the child's anxiety. We included the Cool Kids Dealing with Bullying component as a specific component in Cool Reading. As above, we did not modify the materials of this treatment component.

Progressive Muscle Relaxation. The final specific component of Cool Kids is Progressive Muscle Relaxation, which teaches children relaxation strategies. Progressive Muscle Relaxation is appropriate when children report elevated physiological arousal, or have difficulty with Cognitive Restructuring and require a skill to complete the Gradual Exposure tasks. The Cool Kids Progressive Muscle Relaxation component was included as a specific component in Cool Reading. Again, we did not modify the materials for this component.

COOL READING PROCEDURE

Our Cool Reading treatment components were administered in three 1-hour sessions per week for 12 weeks (36 hours of training in total). The total treatment was equivalent to 10 weeks of reading treatment at the Macquarie University Reading Clinic (i.e., three 45-minute sessions per week for 10 weeks) and 10 weeks of anxiety treatment in Cool Kids (i.e., one 60-to-90-minute session per week for 10 weeks). In line with best practice at the MURC, we developed Cool Reading so that sessions could be delivered to children face-to-face at the Clinic or over the internet using Zoom. The sessions typically include a combination of reading treatment (45 minutes) and anxiety treatment (15 minutes), but some sessions are devoted to anxiety treatment only (60 minutes). Below, we summarise each session across the 12-week programme.

Week 1

Session 1 focused on anxiety treatment. The clinician welcomed the child to the programme, commenced Psychoeducation, goal setting, introduced the worry scale (e.g., how to rate the severity of anxiety), and how to link thoughts and feelings via discussion with the clinician and completion of worksheets. In discussion with the child and parent, the clinician introduced the first homework task on rewards for courageous behaviour.

Session 2 also comprised anxiety treatment. Homework was reviewed and then the clinician introduced activities on Psychoeducation (e.g., how to identify calm and worried thoughts), Detective Thinking, and Controlled Breathing. For homework, the child was required to practice Controlled Breathing and Detective Thinking. Following this, the clinician and parent discussed parenting a child with anxiety.

Session 3 commenced with Controlled Breathing followed by reading treatment. Homework was reviewed and the child practiced Detective Thinking. Homework included Controlled Breathing and Detective Thinking. The clinician checked in with the parent at the end of the session to discuss the child's anxiety.

Week 2

Sessions 4, 5, and 6 commenced with Controlled Breathing followed by reading treatment. Homework was reviewed and the child practiced Detective Thinking in-session. The child was required to continue practicing Controlled Breathing and Detective Thinking for homework. At the end of sessions 4 and 5, the clinician and parent discussed any issues the child experienced at home. At the end of session 6, the clinician and parent discussed how to support children with anxiety.

Week 3

Sessions 7, 8, and 9 commenced with Controlled Breathing followed by reading treatment. In these sessions, the clinician reviewed the child's homework and they practiced Detective Thinking. The homework tasks were to practice Controlled Breathing and

Detective Thinking at home. Following each session, the clinician discussed the child's progress with the parent (sessions 7 and 8) and how to change the conversation around anxiety (session 9).

Week 4

Sessions 10, 11, and 12 commenced with Controlled Breathing followed by reading treatment. Following the homework review, the child, clinician, and parent practiced Detective Thinking. At the end of sessions 10 and 11, the clinician and parent discussed the child's progress. At the end of session 9, the clinician and parent discussed issues around parenting children with anxiety

Week 5

Session 13, 14, and 15 commenced with Controlled Breathing followed by reading treatment. After the child's homework was reviewed, the child was introduced to Gradual Exposures using cartoon videos (sessions 13 and 14) and introduced to the fears and worries list (session 15). Homework was to continue practicing Controlled Breathing and Detective Thinking, and to complete the fears and worries list (session 15). The clinician continued to check in with the parent and discuss the child's application of their skills at home.

Week 6

Sessions 16, 17, and 18 commenced with Controlled Breathing followed by reading treatment. These sessions included a homework review. In session 16, the clinician guided the children through their first Gradual Exposure (e.g., a small non-reading related fear). In session 17, the child, parent, and clinician practiced Detective Thinking. For session 18, the clinician prepared the child for an in-session Gradual Exposure (session 18). Homework was to practice Controlled Breathing, Detective Thinking, and Gradual Exposures. The clinician checked in with the parent at the end of sessions 16 and 17 to discuss progress in Gradual

Exposures. At the end of session 18, the clinician and parent discussed how to build the child's independence and confidence.

Week 7

Session 19 was devoted to anxiety treatment. In this session, the clinician reviewed the child's homework and completed a Detective Thinking activity. Following this, the child completed their first 1 hour in-session Gradual Exposure. The child was required to practice Gradual Exposures for homework.

Sessions 20 and 21 commenced with Controlled Breathing followed by reading treatment. Following the homework review, the child completed a Detective Thinking activity. In session 21, the clinician helped the child plan for their next in-session Gradual Exposure. Homework was to practice Controlled Breathing, Detective Thinking, and Gradual Exposures. At the end of the session, the clinician and parent discussed the child's progress.

Week 8

Session 22 was devoted to anxiety treatment and sessions 23 and 24 to Controlled Breathing followed by reading treatment. Following the review of homework tasks, the child completed an in-session Gradual Exposure (session 22), Detective Thinking (sessions 23 and 24), and planned for the next in-session Gradual Exposure (session 24). For all sessions, the child was required to continue practicing Controlled Breathing, Detective Thinking, and Gradual Exposures for homework. The clinician continued to check in with the parent to discuss any difficulties that the child was having with these tasks at home.

Week 9

Session 25 was devoted to anxiety treatment and sessions 26 and 27 to Controlled Breathing followed by reading treatment. These sessions all required a review of the

homework tasks. The child completed an in-session Gradual Exposure (session 25), a Detective Thinking activity (sessions 26 and 27), and a plan for the next in-session Gradual Exposure (session 27). The child was continually encouraged to practice Controlled Breathing, Detective Thinking, and Gradual Exposures at home. At the end of each session, the clinician and parent discussed the child's Gradual Exposure progress.

Week 10

Session 28 was devoted to anxiety treatment and sessions 29 and 30 to Controlled Breathing followed by reading treatment. Each session necessitated a review of the child's homework. Following this, session 28 included an in-session Gradual Exposure, sessions 29 and 30 included Detective Thinking activities, and session 30 also required planning for another in-session Gradual Exposure. At the end of each session, the child was instructed to practice Controlled Breathing, Detective Thinking, and Gradual Exposures. The clinician and parent discussed any difficulties that the child may be experiencing with these tasks at home.

Week 11

Sessions 31, 32, and 33 commenced with Controlled Breathing followed by reading treatment. This week, the clinician reviewed the child's homework and provided feedback on the child's Gradual Exposure difficulties. The clinician continued to encourage children to practice Controlled Breathing, Detective Thinking, and Gradual Exposures at home. At the end of the session, the clinician continued to help parents troubleshoot any difficulties that they may be having outside the sessions.

Week 12

Sessions 34 and 35 commenced with Controlled Breathing followed by reading treatment. Homework was reviewed. The clinician provided a summary of different coping skills and how children can use their skills to help others. Homework was to practice Controlled Breathing, Detective Thinking, and Gradual Exposures. The clinician completed a

final check in with the parent to address any questions about independently applying these skills in the future.

Session 36 was devoted to anxiety treatment. The final homework tasks were reviewed. The clinician reviewed the child's goals, provided a summary of the child's progress, and discussed a plan for the future. The child was awarded a certificate to celebrate their completion and achievements throughout the programme.

SUMMARY

The goal of this chapter was to introduce and describe Cool Reading – an integrated reading and anxiety treatment for children. We outlined the structure, the evidence base, the clinical tools, and the procedures that support Cool Reading. In the following chapter, we present a pilot study of Cool Reading that was used to refine its procedures to best suit poor readers with anxiety.

REFERENCES

- Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.
- Albano, A., & Kendall, P. C. (2002). Cognitive behavioural therapy for children and adolescents with anxiety disorders: Clinical research advances. *International Review of Psychiatry*, 14, 129-134. doi: 10.1080/0954026022013264 4
- Bell, N. (1986). *Visualizing and verbalizing for language comprehension and thinking*. Paso Robles, CA: Academy of Reading Publications.
- Bittner, A., Egger, H. L., Erkanli, A., Costello, E. J., Foley, D. L., & Angold, A. (2007). What do childhood anxiety disorders predict? *Journal of Child Psychology and Psychiatry*, 48, 1174–1183. doi: 10.1111/j.1469-7610.2007.01812.x
- Boyes, M. E., Leita, S., Claessen, M., Badcock, N. A., & Nayton, M. (2016). Why are reading difficulties associated with mental health problems? *Dyslexia*, 22, 263-266. doi: 10.1002/dys.1531
- Broom, Y. M. & Doctor, E.A. (1995). Developmental surface dyslexia: A case study of the efficacy of a remediation programme. *Cognitive Neuropsychology*, 12, 69–110. doi: 10.1080/02643299508251992
- Brunsdon, R., Coltheart, M., & Nickels, L. (2002). Treatment of irregular word spelling in developmental surface dysgraphia. *Cognitive Neuropsychology*, 22, 213-251. doi: 10.1080/02643290442000077
- Cartwright-Hatton, S., Roberts, C., Chitsabesan, P., Fothergill, C., & Harrington, R. (2004), Systematic review of the efficacy of cognitive behaviour therapies for childhood and adolescent anxiety disorders. *British Journal of Clinical Psychology*, 43, 421-436. doi: 10.1348/0144665042388928

- Castles, A., Coltheart, M., Larsen, L., Jones, P., Saunders, S., & McArthur, G. (2009). Assessing the basic components of reading: A revision of the Castles and Coltheart test with new norms. *Australian Journal of Learning Difficulties*, 14, 67–88. doi: 10.1080/19404150902783435
- Chafouleas, S. M., Martens, B. K., Dobson, R. L., Weinstein, K. S., & Gardner, K. B. (2004). Fluent reading as the improvement of stimulus control: Additive effects of performance- based interventions to repeated reading on students' reading and error rates. *Journal of Behavioural Education*, 13, 67–81. doi: 10.1023/B:JOBE.0000023656.45233.6f
- Chavira, D. A., Drahota, A., Garland, A., Roesch, S., Garcia, M., & Stein, M. B. (2014). Feasibility of two modes of treatment delivery for child anxiety in primary care. *Behaviour, Research, and Theory*, 60, 60-66. doi: 10.1016/j.brat.2014.06.010
- Clarke, P. J., Snowling, M. J., Truelove, E., & Hulme, C. (2010). Ameliorating children's reading-comprehension difficulties: A randomised controlled trial. *Psychological Science*, 21, 1106-1116. doi: 10.1177/0956797610375449
- Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, 108, 204-256. doi: 10.1037/0033-295X.108.1.204
- Compton, S. N., Burns, B. J., Egger, H. L., & Robertson, E. (2002). Review of the evidence base for treatment of childhood psychopathology: Internalising disorders. *Journal of Consulting and Clinical Psychology*, 70, 1240-1266. doi: 10.1037/0022-006X.70.6.1240
- Costello, E. J., Angold, A., & Keeler, G. P. (1999). Adolescent outcomes of childhood disorders: the consequences of severity and impairment. *Journal of the American*

Academy of Child and Adolescent Psychiatry, 38, 121-128. doi: 10.1097/00004583-199902000-00010

Duff, F. J., & Clarke, P. J. (2011). Practitioner review: Reading disorders: what are the effective interventions and how should they be implemented and evaluated? *Journal of Child Psychology and Psychiatry*, 52, 3-12. doi: 10.1111/j.1469-7610.2010.02310.x

Ehri, L. C. (2013). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading*, 18, 5-21. doi: 10.1080/10888438.2013.819356

Ehri, L.C., Nunes, S.R., Stahl, S.A., & Willows, D.M. (2001). Systematic phonics instruction helps students learn to reading: evidence from the national reading panel's meta-analysis. *Review of Educational Research*, 71, 393-447. doi: 10.3102/00346543071003393

Essau, C. A., Lewinsohn, P. M., Olaya, B., & Seeley, J. R. (2014). Anxiety disorders in adolescents and psychosocial outcomes at age 30. *Journal of Affective Disorders*, 163, 125-132. doi:10.1016/j.jad.2013.12.033

Galuschka, K., Ise, E., Krick, K., & Schulte-Korne, G. (2014). Effectiveness of treatment approaches for children and adolescents with reading disabilities: A meta-analysis of randomized controlled trials. *PLoS ONE* 9:e89900. doi: 10.1371/journal.pone.0089900

Gibson, E. J. (1965). Learning to read. *American Association for the Advancement of Science*, 148, 1066-1072. doi: 10.1126/science.148.3673.1066

Ginsburg, G. S., Kendall, P. C., Sakolsky, D., Compton, S. N., Piacentini, J., Albano, A. M. et al. (2011). Remission after acute treatment in children and adolescents with anxiety

- disorders: Findings from the CAMS. *Journal of Consulting and Clinical Psychology*, 79, 806-813. doi: 10.1037/a0025933
- Golinkoff, R. M. (1975). A comparison of reading comprehension processes in good and poor comprehenders. *Reading Research Quarterly*, 4, 624-659. doi: 10.2307/747459
- Gough, P. B. (1972). One second of reading. In J. F. Kavanagh & I. G. Mattingly (Eds.), *Language by ear and by eye: The relationship between speech and reading*. Oxford, England: Massachusetts Inst. of Technology P.
- Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education*, 7, 6-10. doi: 10.1177/074193258600700104
- Grills, A. E., Fletcher, J. M., Vaughn, S., Barth, A., Denton, C. A., & Stuebing, K. K. (2014). Anxiety and response to reading intervention among first grade students. *Child Youth Care Forum*, 43, 417-431. doi: 10.1007/s10566-014-9244-3
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal*, 2, 127-160. doi: 10.1007/BF00401799
- Hudson, J.L., Rapee, R.M., Deveney, C., Schniering, C.A., Lynham, H., & Bovopoulos, N. (2009). Cognitive behavioural treatment versus an active control for children and adolescents with anxiety disorders: A randomised trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48, 533-544. doi: 10.1097/CHI.0b013e31819c2401.
- Ishikawa, S. I., Okajima, I., Matsuoka, H., & Sakano, Y. (2007). Cognitive behavioural therapy for anxiety disorders in children and adolescents: A meta-analysis. *Child and Adolescent Mental Health*, 12, 164-172. doi: 10.1111/j.1475-3588.2006.00433.x
- James, A.C., James, G., Cowdrey, F.A., Soler, A., & Choke, A. (2013). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *Cochrane*

Database of Systematic Reviews, 6, CD004690. doi:

10.1002/14651858.CD004690.pub3.

Jenkins, J.R., Fuchs, L.S., Van Den Broek, P., Espin C., & Deno, S.L. (2003). Sources of individual differences in reading comprehension and reading fluency. *Journal of Educational Psychology*, 95, 719–729. doi: 10.1037/0022-0663.95.4.719

Johnson-Glenberg, M.C. (2000). Training reading comprehension in adequate decoders/poor comprehenders: Verbal vs. visual strategies. *Journal of Educational Psychology*, 92, 772–782. doi: 10.1037/0022-0663.92.4.772

Kendall, P.C. (2000). *Child and adolescent therapy: cognitive-behavioural procedures* (2nd ed.). New York: Guilford Press.

Kohnen, S. & Banales, E. (2015a). *The Macquarie University Reading Clinic Reading Gap intervention program*. Sydney: Macquarie University.

Kohnen, S. & Banales, E. (2015b). *The Macquarie University Reading Clinic Spelling Gap intervention program*. Sydney: Macquarie University.

Kohnen, S. & Banales, E. (2015c). *The Macquarie University Reading Clinic Sight words intervention program*. Sydney: Macquarie University.

Kohnen, S. & Banales, E. (2015d). *The Macquarie University Reading Clinic Blending intervention program*. Sydney: Macquarie University.

Kohnen, S. & Banales, E. (2015e). *The Macquarie University Reading Clinic Segmentation intervention program*. Sydney: Macquarie University.

Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.

Kuhn, M.R., & Stahl, S.A. (2003). Fluency: A review of developmental and remedial practices. *Journal of Educational Psychology*, 95, 3-21. doi: 10.1037/0022-0663.95.1.3

- Laberge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology*, 6, 293-323. doi: 10.1016/0010-0285(74)90015-2
- Lee, J., & Yoon, S. Y. (2017). The effects of repeated reading on reading fluency for students with reading disabilities. A meta-analysis. *Journal of Learning Disabilities*, 50, 213-224. doi: 10.1177/0022219415605194
- Lovett, M. W. (1984). A developmental perspective on reading dysfunction: Accuracy and rate in the subtyping of dyslexic children. *Brain and Language*, 22, 67-91. doi: 10.1016/0093-934X(84)90080-4
- Luciano, S., & Savage, R. S. (2007). Bullying risk in children with learning difficulties in inclusive educational settings. *Canadian Journal of School Psychology*, 22, 14-31. doi: 10.1177/0829573507301039
- Lyneham, H.J., Abbott, M.J., & Rapee, R.M. (2006). Evaluation of therapist-supported parent-implemented CBT for anxiety disorders in rural children. *Behaviour Research & Therapy*, 44, 1287-1300. doi: 10.1016/j.brat.2005.09.009
- Lyneham, H. J., Abbott, M. J., Wignall, A., & Rapee, R.M. (2003). *The Cool Kids Anxiety Treatment Program* Sydney, Australia: MUARU, Macquarie University
- McArthur, G., Eve, P., Jones, K., Banales, E., Kohnen, S., Anandakumar, T. et al. (2012). Phonics training for English-speaking poor readers. *Cochrane Database of Systematic Reviews*, 12. doi: 10.1002/14651858.CD009115.pub2.
- McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015a). Sight word and phonics training in children with dyslexia. *Journal of Learning Disabilities*, 48, 391-407. doi: 10.1177/0022219413504996
- McArthur, G., Kohnen, S., Jones, K., Eve, P., Banales, E., Larsen, L., & Castles, A. (2015b). Replicability of sight word training and phonics training in poor readers: A randomised controlled trial. *PeerJ* 3:e922. doi: 10.7717/peerj.922

- McArthur, G., Sheehan, Y., Badcock, N. A., Francis, D. A., Wang, H. C., Kohnen, S. et al. (2018). Phonics training for English-speaking poor readers (Review). *Cochrane Database of Systematic Reviews* 11. doi: 10.1002/14651858.CD009115.pub3
- Mifsud, C., & Rapee, R. (2005). Early intervention for childhood anxiety in a school setting: Outcomes for an economically disadvantaged population. *Journal of American Academy for Child and Adolescent Psychiatry*, 44, 996-1004. doi: 10.1097/01.chi.0000173294.13441.87
- Morris, R. D., Stuebing, K. K., Fletcher, J. M., Shaywitz, S. E., Lyon, G. R., Shankweiler, D. P., et al. (1998). Subtypes of reading disability: Variability around a phonological core. *Journal of Educational Psychology*, 90, 347-373. doi: 10.1037/0022-0663.90.3.347
- Mychailyszyn, M., Mendez, J., & Kendall, P. (2010). School functioning in youth with and without anxiety disorders: Comparisons by diagnosis and comorbidity. *School Psychology Review*, 39, 106-121.
- Nation, K., & Snowling, M. (1997). Assessing reading difficulties: The validity and utility of current measures of reading skill. *British Journal of Educational Psychology*, 67, 359-379. doi: 10.1111/j.2044-8279.1997.tb01250.x
- National Reading Panel (NRP). (2000). *Report of the National Reading Panel: Reports of the Subgroups*. Washington, DC: National Institute of Child Health and Human Development Clearing House.
- Oakhill, J. (1984). Inferential and memory skills in children's comprehension of stories. *British Journal of Educational Psychology*, 54, 31-39. doi: 10.1111/j.2044-8279.1984.tb00842.x

- Oakhill, J.V., & Patel, S. (1991). Can imagery training help children who have comprehension problems? *Journal of Research in Reading, 14*, 106–115. doi: 10.1111/j.1467-9817.1991.tb00012.x
- Palincsar, A.S., & Brown, A.L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*, 117– 175. doi: 10.1207/s1532690xci0102_1
- Perfetti, C.A. (1985). *Reading ability*. London: Oxford University Press.
- Perfetti, C. A. (1992). The representation problem in reading acquisition. In P. Gough, L. Ehri, & R. Trieman (Eds.), *Reading acquisition*. Mahwah, NJ: Erlbaum.
- Perfetti, C. A., & Hogaboam, T. (1975). Relationship between single word decoding and reading comprehension skill. *Journal of Educational Psychology, 67*, 461-469.
- Rapee, R. M., Wignall, A., Hudson, J. L., & Schniering, C. A. (2000). *Evidence-based treatment of child and adolescent anxiety disorders*. Oakland, CA: New Harbinger.
- Rapee, R. M., Abbott, M.J., & Lyneham, H. J. (2006). Bibliotherapy for children with anxiety disorders using written materials for parents: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 74*, 436-444. doi: 10.1037/0022-006X.74.3.436
- Rouse, H. J., & Wilshire, C. E. (2007). Comparison of phonological and whole-word treatments for two contrasting cases of developmental dyslexia. *Cognitive Neuropsychology, 24*, 817-842. doi: 10.1080/02643290701764207
- Settipani, C. A., & Kendall, P. C. (2013). Social functioning in youth with anxiety disorders: Association with anxiety severity and outcomes from cognitive-behavioral therapy. *Child Psychiatry and Human Development, 44*, 1-18. doi:10.1007/s10578-012-0307-0
- Shinn, M.R., Good, R.H., Knuston, N., Tilly, W.D., & Collins, V.C. (1992). Curriculum-based measurement of oral reading fluency: A confirmatory analysis of its relation to

- reading. *School Psychology Review*, 21, 459-479.
- Silverman, W.K., & Albano, A.M. (1996). *The Anxiety Disorders Interview Schedule for Children for DSM-IV: Child and Parent Versions*. San Antonio, TX: Psychological Corporation.
- Simmons, D. C., & Kameenui, E. D. (1998). *What reading research tells us about children with diverse learning needs: Bases and basics*. Mahway, NJ: Erlbaum.
- Smart, D., Youssef, G. J., Sanson, A., Prior, M., Toumbourou, J. W., & Olsson, C. A. (2017). Consequences of childhood reading difficulties and behaviour problems for educational achievement and employment in early adulthood. *British Journal of Educational Psychology*, 87, 288-308. doi: 10.1111/bjep.12150
- Therrien, W. J. (2004). Fluency and comprehension gains as a result of repeated reading. *Remedial and Special Education*, 25, 252-261. doi: 10.1177/07419325040250040801
- Van Ameringen, M., Mancini, C., & Farvolden, P. (2003). The impact of anxiety disorders on educational achievement. *Journal of Anxiety Disorders*, 17, 561-571. doi: 10.1016/S0887-6185(02)00228-1
- Verduin, T. L., & Kendall, P. C. (2008). Peer perceptions and liking of children with anxiety disorders. *Journal of Abnormal Child Psychology*, 36, 459-469. doi: 10.1007/s10802-007-9192-6

APPENDIX

Table A

Session plan overview and summary of session structure for Cool Reading

Week	Session	Reading Training	Anxiety Training	
		Child	Child and parent	Parent
1	1	None	Welcome Psychoeducation videos Goal setting Worry scale What are thoughts activity Cool Reading Mission: ○ Thoughts and feelings ○ Rewards menu	Rewarding Children for Managing Anxiety
	2	None	Homework Review ○ Review thoughts and feelings ○ Rewards menu Calm and worried thoughts Cognitive Restructuring videos Controlled Breathing Homework ○ Controlled Breathing ○ Cognitive Restructuring	Anxiety Parenting Traps Anxiety, Misbehaviour, or Typical Child
	3	Cool Breathing + Reading Training ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i>	Homework Review ○ Cognitive Restructuring In-session Detective Thinking Homework ○ Controlled Breathing ○ Cognitive Restructuring	Check in & Problem Solve
2	4	Cool Breathing + Reading Training ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i>	Homework Review ○ Cognitive Restructuring In-session Detective Thinking Homework ○ Controlled Breathing ○ Cognitive Restructuring	Check in & Problem Solve
	5	Cool Breathing + Reading Training ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i>	Homework Review ○ Cognitive Restructuring In-session Detective Thinking Homework ○ Controlled Breathing Cognitive Restructuring	Check in & Problem Solve
	6	Cool Breathing + Reading Training ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i>	None	Provide Support without Encouraging Anxiety
3	7	Cool Breathing + Reading Training ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i>	Homework Review ○ Cognitive Restructuring In-session Detective Thinking	Check in & Problem Solve

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	<ul style="list-style-type: none"> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework <ul style="list-style-type: none"> ○ Controlled Breathing Cognitive Restructuring	
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring In-session Detective Thinking Homework <ul style="list-style-type: none"> ○ Controlled Breathing Cognitive Restructuring	Check in & Problem Solve
8			
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	None	Change the Conversation
9			
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring In-session Detective Thinking Homework <ul style="list-style-type: none"> ○ Controlled Breathing Cognitive Restructuring	Check in & Problem Solve
10			
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring In-session Detective Thinking Homework <ul style="list-style-type: none"> ○ Controlled Breathing Cognitive Restructuring	Check in & Problem Solve
4			
11	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring In-session Detective Thinking Homework <ul style="list-style-type: none"> ○ Controlled Breathing Cognitive Restructuring	Check in & Problem Solve
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	None	Parenting a Child who has Anxiety Parent Action Plan
12			
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring Introducing Gradual Exposure <ul style="list-style-type: none"> ○ Abby's Fear ○ Helping Abby Face her Fear ○ How to Make a Stepladder Homework <ul style="list-style-type: none"> ○ Controlled Breathing ○ Cognitive Restructuring 	Check in & Problem Solve
13			
5			
	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring Gradual Exposure <ul style="list-style-type: none"> ○ Tricks to stepladders ○ Stepladder examples Homework <ul style="list-style-type: none"> ○ Controlled Breathing ○ Cognitive Restructuring 	Check in & Problem Solve
14			

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		Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Controlled Breathing ○ Cognitive Restructuring Fears and worries list Homework <ul style="list-style-type: none"> ○ Fears and worries list ○ Cognitive Restructuring ○ Controlled Breathing 	Fighting Fear by Facing Fear
		Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Cognitive Restructuring ○ Fears and worries list Creating first Gradual Exposure <ul style="list-style-type: none"> ○ Non-reading fear Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	Check in & Problem Solve
6	17	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	Check in & Problem Solve
	18	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Instant Detective Thinking In-session step ladder preparation Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	— Challenges to Exposure — Build Independence & Confidence — Parent Action Plan
	19	— None	Homework Review <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing In session Exposure Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	— Check in & Problem Solve
7	20	Cool Breathing + Reading Training <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	Homework Review <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	— Check in & Problem Solve
	21	Cool Breathing + Reading Training	Homework Review	— Check in & Problem

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		<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	Solve
		Gradual Exposure preparation	Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	—	None	Homework Review	— Check in & Problem Solve
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	22		In session Exposure	
			Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
		Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
		<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
8	23		Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
		Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
		<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	24		Gradual Exposure preparation	
			Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	—	None	Homework Review	— None
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	25		In session Exposure	
			Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
9		Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
		<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
	26		Homework	
			<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	

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27	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Gradual Exposure preparation Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
28	— None	Homework Review	— None
		<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing In session Exposure Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
10 29	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
30	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
31	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
11 32	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve
	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing Homework <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
33	Cool Breathing + Reading Training	Homework Review	— Check in & Problem Solve

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	<ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing <p>Homework</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	
34	<p>Cool Breathing + Reading Training</p> <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<p>Homework Review</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing <p>Homework</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	— Check in & Problem Solve
35	<p>Cool Breathing + Reading Training</p> <ul style="list-style-type: none"> ○ <i>MURC Reading Gaps</i> ○ <i>MURC Spelling Gaps</i> ○ <i>MURC Reading and Spelling Sight Words</i> ○ <i>MURC Text Reading Accuracy</i> 	<p>Homework Review</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing <p>How I can help others</p> <p>Homework</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing 	— Check in & Problem Solve
12			
36	— None	<p>Homework Review</p> <ul style="list-style-type: none"> ○ Gradual Exposure ○ Cognitive Restructuring ○ Controlled Breathing <p>Goal Review</p> <p>Plan for the future</p> <p>Certificate and congratulations!</p>	— None

CHAPTER 5

Refining the Cool Reading Programme: An Interventional Pilot Study

Author's statement: DF was responsible for the content of this paper, for the data collection, and data analysis. DF, GM, and JH contributed to the writeup of this manuscript and provided feedback on the revisions of this paper. LM (clinical psychologist) collected data for anxiety disorder outcomes at T2. JH worked on developing and refining the intervention

manual, provided DF with supervision for assessment and treatment. HL also contributed to the development of the anxiety treatment manual.

ABSTRACT

There is reliable evidence for an association between poor reading and anxiety. However, there are currently no integrated reading and anxiety interventions to treat children with these difficulties. As outlined in Chapter 4, we have developed a unique integrated reading and anxiety treatment for poor readers with anxiety, which we called “Cool Reading”. In the current study, we aimed to determine if the reading or anxiety treatment components of Cool Reading required any modifications to better suit children with reading and anxiety problems. We also explored if Cool Reading improved reading and anxiety outcomes. In a pilot interventional case series, four children completed 12 weeks of Cool Reading treatment. We found that Cool Reading had an effect on general reading skills (reading comprehension, reading accuracy), the nonlexical reading route and some of its components (nonword reading accuracy, nonword reading fluency, nonword spelling, GPC knowledge), and the lexical reading route (irregular spelling). We also found that Cool Reading had positive effects on anxiety, although these were milder than predicted. Taken together, the results suggest that Cool Reading may be a promising intervention to improve reading and anxiety for children, particularly with modifications to some of the anxiety treatment components.

Keywords: poor reading; anxiety disorders; integrated treatment.

INTRODUCTION

In this thesis thus far, we have discovered that poor readers with anxiety have mixed and severe reading problems, are at risk for clinically elevated anxiety, and struggle with social anxiety, poor reading self-concept, and poor attention (Chapters 2 and 3). To help these children, we developed Cool Reading, which is the first combined reading and anxiety treatment for children (Chapter 4). In this chapter, we describe an interventional pilot study that tested Cool Reading with poor readers with anxiety for the first time.

Reading treatment components of Cool Reading

In Chapter 4, we outlined the evidence-based clinical tools that we selected to deliver the reading treatment components of Cool Reading. We selected reading treatments that have been found to be effective at the group level by scientific studies (McArthur et al., 2015a; 2015b) and at the individual level in the Macquarie University Reading Clinic (MURC). Although these reading treatments have frequently been used with poor readers, to our knowledge, they have not been delivered to poor readers with anxiety specifically. This raises three issues. First, we do not know how poor readers with clinical anxiety respond to reading treatment. One study has administered reading treatment to poor readers with anxiety, but the poor readers did not have clinically severe anxiety (Grills, Fletcher, Vaughn, Barth, Denton, & Stuebing, 2014). Second, the phonics reading treatment that we selected for Cool Reading requires that the clinician does not tell the child if their response is correct or incorrect on the test items which are used to measure progress. This element of uncertainty (i.e., not knowing if they are correct or incorrect) may escalate children's anxiety during this component of reading treatment. Third, many poor readers struggle to motivate themselves to practice reading as they are aware of their skill deficit. Lack of self-motivation may be particularly problematic for poor readers with clinical levels of anxiety who may feel under threat. The poor readers lack of motivation may hence reduce their exposure to reading and further limit

their engagement in self-teaching processes through lack of exposure to print. With these issues in mind, the first aim of this study was to pilot the reading treatments in our version of Cool Reading to determine if and how these treatments should be modified to best meet the specific needs of poor readers with anxiety.

Anxiety treatment components of Cool Reading

We are also unclear about certain aspects of the anxiety treatments in Cool Reading. First, we do not know if or how poor readers with clinical anxiety will respond to the core and specific anxiety treatments in Cool Reading. Poor readers are typically excluded from anxiety treatment studies (e.g., James, James, Cowdrey, Soler, & Choke, 2013) because most anxiety treatments for children are manualised (i.e., workbook based) and hence rely on children's ability to read the materials to complete the intervention (e.g., the Cool Kids for Anxiety program; Lyneham, Abbott, Wignall, & Rapee, 2003). As described in Chapter 4, we have modified the core anxiety components of Cool Kids to reduce the amount of reading as much as possible, and simplified any remaining written text that has to be presented. Nevertheless, we currently do not know if these modifications will make the context of Cool Reading sufficiently accessible to poor readers with anxiety.

A second major modification that we made to the Cool Kids programme to create Cool Reading was the session structure. In Cool Kids, 10 sessions (60 to 90 minutes per session) are completed over 12 weeks. The first eight sessions are scheduled weekly and the last two sessions are scheduled fortnightly. In Cool Reading, treatment was completed over 12 weeks and included three 60-minute sessions per week for 12 weeks. The treatment in Cool Reading also included a combination of reading and anxiety treatments. We did not know if poor readers with anxiety would respond well to this structure because, to our knowledge, poor reading and anxiety treatments have never been administered in a combined way both within and between sessions.

A third facet of Cool Reading that we do not yet understand is whether poor readers with anxiety are able to switch between reading treatment and anxiety treatment within a single treatment session. In the past, if a poor reader with anxiety was accurately diagnosed with both disorders, they would have received treatment for each problem separately, or received treatment for just poor reading or anxiety. This approach is reflected by the research literature, which suggests that just one study has administered an intervention to poor readers with anxiety, and this intervention focused solely on reading (Grills et al., 2014). The administration of reading and anxiety treatment that is integrated both within and across treatment sessions has never been tested in children with poor reading and anxiety. Hence, we do not know if these children can cope with switching between these two very different types of treatment within a session.

In sum, there are three aspects of the anxiety treatment in Cool Reading that need clarification. Thus, the second aim of this study was to pilot test the core and specific anxiety treatments in Cool Reading to determine if and how the procedures should be modified to suit children with concomitant reading and anxiety problems.

Reading outcomes

A third aim of this pilot study was to begin to understand if Cool Reading has an effect on reading outcomes in children with poor reading and anxiety. In this pilot study, we included outcomes measures for the three general reading skills that are trained by Cool Reading treatment components: word accuracy, reading fluency, and reading comprehension (see Table 1 and the “Reading measures” section below for the reading outcome measures). We also explored the impact of Cool Reading on the cognitive components of the word reading accuracy system since (1) we found word accuracy was associated with concomitant reading and anxiety problems in children in Chapter 3, and (2) word accuracy is a foundational reading skill for reading fluency, and reading comprehension (Golinkoff, 1975;

Hoover & Gough, 1990; LaBerge & Samuels, 1974; Perfetti & Hogboam, 1970) which are frequently impaired in children with poor reading.

Guided by multiple cognitive models of reading, researchers have outlined the cognitive components of the word reading system including triangle models and dual route models (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989). In this pilot study, we were guided by the dual route cascaded model of reading words aloud (DRC; Coltheart et al., 2001; see Figure 1) because it provides the most explicit account of which cognitive components are involved in reading words, and how those components relate to each other.

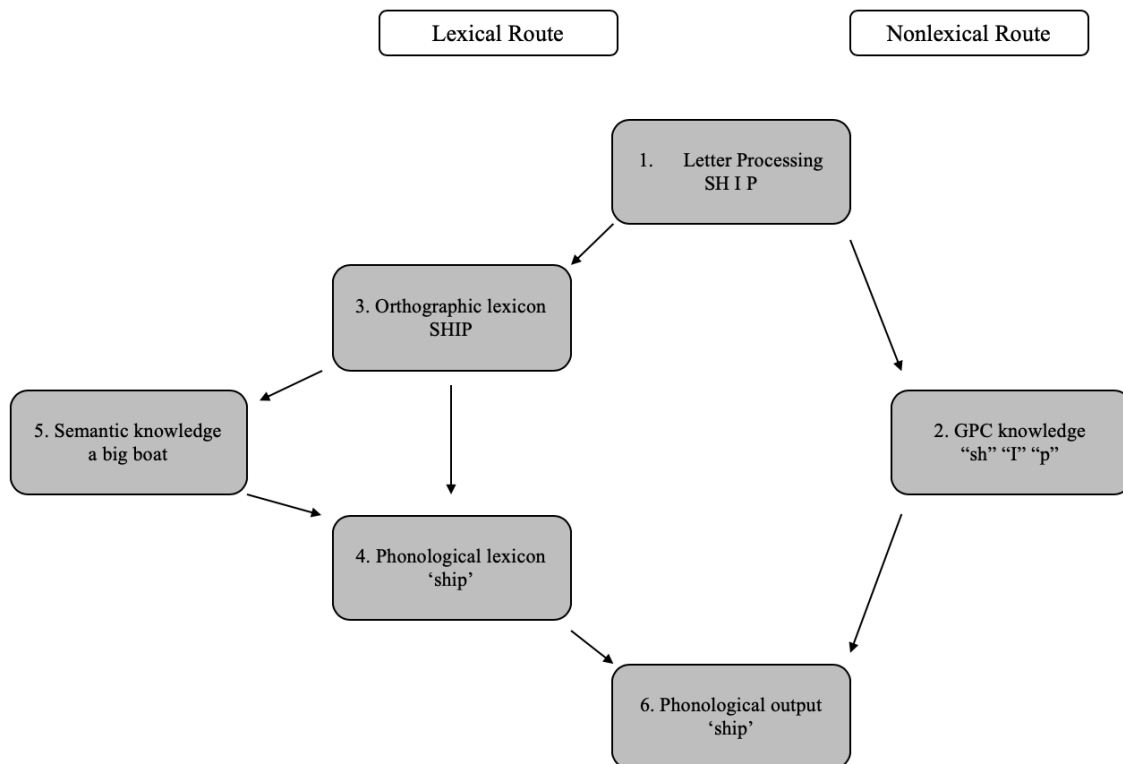


Figure 1. A summary of the Dual Route Cascaded (DRC) model of reading aloud, including the nonlexical and lexical routes and the individual components of both routes (see boxes 1 to 6).

According to the DRC, reading aloud occurs via activation of the individual cognitive components of a nonlexical reading route and a lexical reading route (Coltheart et al., 2001).

Processing in both routes begins with the identification and ordering of letters in a written

word (e.g., SHIP; see letter processing component in Figure 1 in box 1). In the nonlexical route, this letter processing triggers the translation of letters and letter clusters (graphemes; e.g., SH I P) into sounds (phonemes; “sh” “i” “p”) via learned grapheme-phoneme correspondence (GPC) rules (see GPC component in box 2). At the same time, in the lexical route, the orthographic lexicon searches its store of known letter strings to see if it can find a match with SHIP (see orthographic lexicon component in box 3). A match activates the spoken version of the word (“ship”; see phonological lexicon component in box 4) either directly or indirectly via the meaning of the word (a big boat; see semantics component in box 5). Activation of the phonological lexicon in the lexical route (box 4), and the GPC component in the nonlexical route (box 2), in turn activates the pronunciation of the word (“ship”; see phonological output component in box 6) and the word is read aloud.

There are five things to note about the DRC model of word reading. First, it models the ability to read words aloud, which is appropriate for the current pilot study since Cool Reading requires children to read words aloud during both assessment and treatment. Second, the presentation of a written word activates both routes simultaneously. It is not the case that only one route is activated (e.g., the nonlexical route), or that one route is activated before the other (e.g., nonlexical then lexical route). Third, although written words are processed by both routes simultaneously, some words are processed more accurately in one route than the other. Specifically, unknown (i.e., not yet learned) regular words that follow the GPC rules (i.e., novel real words or nonsense nonwords) are read more accurately by the nonlexical route than the lexical route. Conversely, known (i.e., learned) irregular words are read more accurately by the lexical route than the nonlexical route. It therefore follows that, fourth, unknown regular words or nonwords are often used to assess the functioning of the nonlexical route, while irregular words are often used to assess the lexical route. Finally, the DRC predicts that a child with a specific impairment in their nonlexical route (i.e., the GPC

component) will have poor nonword reading but intact irregular word reading. This pattern of reading impairment has been called phonological dyslexia (Coltheart, 1996; Temple & Marshall, 1983). A child with a specific impairment in their lexical route (i.e., orthographic lexicon component, phonological lexicon component, semantic component) will have poor irregular word reading but intact nonword reading. This pattern of reading impairment has been called surface dyslexia (Castles & Coltheart, 1996). A child with impairments in components in both routes, or in a component common to both routes (i.e., letter processing or phonological output) will have poor nonword and irregular word reading. This pattern of reading impairment has been called mixed dyslexia (Brunsdon, Hannan, Nickels, & Coltheart, 2002; Castles & Coltheart, 1996; Goulandris & Snowling, 1991; Wang, Nickels, & Castles, 2015).

In sum, a third aim of this pilot study was to explore if Cool Reading has an effect on reading outcomes in children with poor reading and anxiety. In line with the Cool Reading treatment components, we assessed three general reading skills: word accuracy, reading fluency, and reading comprehension. In line with the DRC, we assessed the nonlexical and lexical reading routes, as well as cognitive components that comprise these routes. The measures we used to assess these outcomes are summarised in Table 1 and outlined below in the Methods under the “Reading outcomes measures” section.

Anxiety outcomes

The fourth aim of this pilot study was to explore if Cool Reading has an effect on anxiety outcomes. Specifically, we were interested in the effect of Cool Reading on anxiety disorders (e.g., social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, specific phobias, panic disorder, obsessive-compulsive disorder). We were also interested in exploring if Cool Reading had an effect on six anxiety symptoms (e.g., social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms, physical

injury fears, panic/agoraphobia symptoms, obsessive-compulsive symptoms) and three types of anxiety interference (home interference, outside home interference, parent life interference). Below, we discuss anxiety disorders, anxiety symptoms, and anxiety interference in more detail.

Anxiety disorders

Anxiety disorders are classified using categorical systems such as the Diagnostic and Statistical Manual (DSM: now in its 5th edition: DSM-5; American Psychiatric Association (APA), 2013). These classifications indicate that anxiety is significantly distressing or interfering for the child. These disorders often develop during childhood and persist into adulthood if left untreated (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Kessler, Berglund, Demler, Jin, Merikangas, & Walters, 2005; Pine, Cohen, Gurley, Brook, & Ma, 1998). Four of the most common childhood anxiety disorders include social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, and specific phobias (Lawrence et al., 2015). Panic disorder is less common in childhood and obsessive-compulsive disorder has recently been removed from the anxiety disorder classification. Nonetheless, these disorders share many common symptoms (e.g., avoidance, physical symptoms, interference) but are also separated by independent clinical features. Specifically, social anxiety disorder is defined by the threat of negative evaluation and worries about humiliation, embarrassment, rejection, and anxiety in social situations. Children may also avoid, or become distressed, in situations relating to performance (e.g., reading aloud, taking tests, sporting events) or social interaction (e.g., group activities, interacting with peers or adults, standing up for oneself). Hence, socially anxious children avoid or endure such situations with great distress (APA, 2013).

It is possible that social anxiety is the most closely associated anxiety problem with poor reading given the potential risk of negative evaluation (e.g., reading aloud for poor readers) and the threat of negative evaluation for social anxiety (see Chapter 3). However, we do not know if poor reading is also associated with other anxiety disorders. For instance, generalised anxiety disorder is defined by numerous, pervasive, and uncontrollable worries in areas relating to school, friendships, or health, and may also include physical symptoms (e.g., irritability, poor concentration, muscle aches, sleeping difficulties). Separation anxiety disorder is defined by worry about separation from loved ones, poor sleep, nightmares about separation, and physical symptoms such as nausea or vomiting. Specific phobias are another type of anxiety disorder commonly experienced by children and include situations or objects that children avoid or endure with extreme distress. Common specific phobias are animal phobias (e.g., spiders, insects), injury phobias (e.g., injections), situational phobias (e.g., planes, elevators), or other phobias (e.g., dentist, loud noises). When children encounter specific phobias they may run away, cling to their parent or caregiver, cry, or freeze. Panic disorder is defined by the sudden onset of anxiety without any known cause, and may be present with or without agoraphobia (i.e., anxiety around not being able to escape). Finally, obsessive-compulsive disorder, (closely related to the anxiety disorders), is defined by repetitive thoughts or images and/or anxiety associated with special behaviours (APA, 2013).

Anxiety symptoms

Anxiety symptoms, such as uncontrollable worry and excessive worried thoughts, are features of anxiety disorders that describe the experience of anxiety (APA, 2013). Children may report mild or moderate anxiety symptoms that fall below a clinical threshold and do not necessarily warrant a diagnosis of an anxiety disorder (Bell-Dolan, Last, & Strauss, 1990). According to the dimensional approach, anxiety occurs along a continuum of severity rather than falling into discrete categories (Krueger & Eaton, 2015). Anxiety symptoms can also be

measured under the disorder types listed above, and may fall within categories such as social anxiety symptoms (e.g., I am afraid I will make a fool of myself in front of people), generalised anxiety symptoms (e.g., I worry about things), separation anxiety symptoms (e.g., I worry about being away from my Mum or Dad), physical injury fears (e.g., I am scared of the dark), panic/agoraphobia (e.g., When I have a problem my heart beats really fast), obsessive-compulsive symptoms (e.g., I have to think special thoughts to stop bad things from happening; Spence, 1999). As mentioned above, some anxiety symptoms are unique to specific disorders (e.g., fear of embarrassment in social anxiety) while other symptoms overlap between many disorders (e.g., physical symptoms in separation anxiety disorder and generalised anxiety disorder).

Anxiety interference

Anxiety interference refers to the impact that the anxiety symptoms may have on a child's life, and can indicate that anxiety is maladaptive (Lyneham et al., 2013; Muris & Meesters, 2002; Rapee, Schniering, & Hudson, 2009; Silverman & Ollendick, 2008). Anxiety may interfere with peer relationships (e.g., developing new friendships, interactions with other children; Strauss, Frame, & Forehand, 1987), school participation (e.g., school absentees, academic performance; Karlsson et al., 2006), or home life (e.g., participation in family activities; Langley, Bergman, McCracken, & Piacentini, 2004).

In sum, a fourth aim of this pilot study was to explore if Cool Reading has an effect on anxiety outcomes in children with poor reading and anxiety. We assessed for the presence of six anxiety disorders (social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, specific phobias, panic disorder, obsessive-compulsive disorder), six types of anxiety symptoms (social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms, physical injury fears, panic/agoraphobia symptoms, obsessive-compulsive symptoms), and three types of anxiety interference (home interference, outside home

interference, parent life interference). The measures we used to assess these outcomes are summarised in Table 1 and outlined below in the Methods under the “Anxiety outcome measures” section.

Summary

Cool Reading is a new integrated reading and anxiety treatment for children. Cool Reading has never been administered before and so we do not know if it is suitable for children with concomitant poor reading and anxiety. Therefore, the current study pilot tested the administration and outcomes of Cool Reading with four individual children with concomitant reading and anxiety problems. The first and second aims of the study were to determine if the reading (Aim 1) or anxiety (Aim 2) treatment components required any modifications to better suit children with reading and anxiety problems. The third aim was to explore if Cool Reading improves outcomes for general reading skills, the nonlexical and lexical reading routes, and components of these routes (Aim 3). And the fourth aim was to investigate if Cool Reading improves outcomes for anxiety disorders, anxiety symptoms, and anxiety interference (Aim 4). It is important to note that in this pilot study we wanted to determine the usability of the Cool Reading treatment materials for poor readers with anxiety. Hence, in this first administration of Cool Reading we did not collect control data. We made no specific hypotheses about the direction of the intervention effects as no study has administered integrated reading and anxiety treatment to poor readers with anxiety. Hence, while we may anticipate that integrated reading and anxiety treatment would significantly lower reading and improve anxiety outcomes based on separate training of these disorders, it is unknown if such integrated training would have the same effect. Thus, the results relating to Aims 3 and 4 were considered exploratory and suggestive rather than definitive.

METHOD

Ethics Approval

The Macquarie University (MQ) Human Ethics Committee (Reference: 5201500286) approved the methods outlined below. Children participated in this study with written parental consent. Verbal consent was also obtained from children, and parents and children were reminded throughout the study that they could withdraw at any time without consequence.

Study design and procedures

This study comprised four phases: a recruitment phase (Test 1; T1), a pre-intervention assessment (also at T1), an intervention phase, and a post-intervention assessment (Test 2; T2). At T1, children and their parents were administered recruitment measures (to ascertain eligibility), profiling measures (to understand their profiles in terms of reading, anxiety, verbal and nonverbal cognitive ability, and potential "linking variables " from Chapter 3), and reading and anxiety outcome measures (to test the effects of Cool Reading; see Table 1 for a summary of outcome measures). The total assessment time was approximately 4 hours for children and 2 hours for parents. DF administered all the recruitment, profiling, and outcome measures at T1 in face-to-face sessions at the MURC.

The intervention phase delivered 36 Cool Reading treatment sessions (1 hour per session) to each child individually. The sessions were administered three times per week for 12 weeks. Children completed the sessions before or after school either at the MURC or via Zoom. The MURC has found Zoom to be as effective as face-to-face sessions for treatment delivery. If children were sick or parents were unable to make a training session, parents were invited to re-schedule additional sessions the same week to ensure three sessions per week were completed. Children received a gold coin sticker that represented \$2.70 at the end of every intervention session. DF administered the intervention to each child. She was trained by the MURC and the Macquarie University Centre for Emotional Health Clinic (MQCEH) to deliver reading and anxiety treatment components, respectively. DF received weekly

clinical supervision from JH (third author and Director of the MQCEH) to discuss case formulation and individualisation of therapy.

At T2, children and parents attended the MURC to complete the outcome measures only. The assessment time for children was around two hours. DF administered all the reading outcome measures and two anxiety outcome measures (anxiety symptoms, anxiety interference) since they were standardised and normed, hence minimising assessor bias. The remaining outcome measure for anxiety disorders was qualitative and hence dependent upon assessor interpretation. Thus, at T2, an independent clinical psychologist, LM, who did not administer any measures at T1 or any intervention, administered the anxiety disorder outcome measure to minimise assessor bias. Parents received written reports of their child's performance on the T1 and T2 assessments and verbal updates regarding treatment progress throughout the intervention. At the end of their T2 session, children were given \$100 to reimburse them for their time and effort across all stages of the study.

Table 1

Cool Reading assessment measures and clinical tools, indicating the chapter that described each clinical tool

Outcome	Clinical Tool	Reference	Chapter
Recruitment			
Nonword reading accuracy	Castles and Coltheart Reading Test, Second Edition (CC2)	Castles et al., 2009	3
Irregular reading accuracy	CC2	Castles et al., 2009	
Anxiety disorders	Anxiety Disorders Interview Schedule – child and parent report (ADIS-C/P)	Silverman & Albano, 1996	5
Profiling			
Reading self-concept	Reading Self-Concept Scale	Chapman & Tunmer, 1995	3
Peer problems	Strengths and Difficulties (SDQ-P)	Goodman, 1997	3
Peer relationships	Conner's 3 rd edition (Conner's-P)	Conners, 2008	5
Inattention	Conner's-P	Conners, 2008	5
Hyperactivity	Conner's-P	Conners, 2008	5
Combined inattention & hyperactivity	SDQ-P	Goodman, 1997	3
Conduct symptoms	SDQ-P	Goodman, 1997	3
Aggression & aggression	Conner's-P	Conners, 2008	5
Nonverbal cognitive ability	Kaufman Brief Intelligence Test 2 nd Edition (K-BIT-II)	Kaufman & Kaufman, 2004	5

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Verbal cognitive ability	Clinical Evaluation of Language Fundamentals 4 th Edition (CELF) Outcomes	Semel, Wiig, & Secord, 2003	5
General reading			
Word reading accuracy	CC2	Castles et al., 2009	3
Word reading fluency	Test of Word Reading Efficiency (TOWRE)	Torgesen, Wagner, & Rashotte, 1999	3
Text reading fluency	Wheldall Assessment of Reading Passages (WARP)	Wheldall & Madeleine, 2000	5
Reading comprehension	Neale Analysis of Reading Ability 2 nd Edition (NARA)	Neale, 1999	5
Nonlexical reading route			
Nonword reading accuracy	CC2	Castles et al., 2009	3
Nonword reading fluency	TOWRE	Torgesen, Wagner, & Rashotte, 1999	3
Nonword spelling	Queensland Inventory of Literacy (QUIL)	Dodd, Holm, Oerlemans, & McCormick, 1996	3
Lexical reading route			
Irregular reading accuracy	CC2	Castles et al., 2009	3
Irregular word spelling	Diagnostic Spelling Test for Irregular Words (DiSTi)	Kohnen, Colenbrander, & Nickels, 2012	3
Components of the nonlexical and lexical routes			
Letter identification	Cross-Case Copying	McArthur et al., 2013	5
GPC knowledge (graphemes)	Letter Sound Test (LeST)	Larsen, Kohnen, Nickels, & McArthur, 2015	5
GPC knowledge (nonwords)	Diagnostic Reading Test (DiRT)	Colenbrander, Kohnen, & Nickels, 2011	5
PGC knowledge	Diagnostic Spelling Test – Nonwords (DiSTn)	Kohnen, Nickels, & Castles, 2009	5
Orthographic lexicon	Test of Orthographic Choice (TOC)	Kohnen, Anandakumar, McArthur, & Castles, 2012	5
Orthographic-semantic link	Meaning of Written Words	Kohnen, Larsen, Jones, Castles, & McArthur, 2012	5
Anxiety			
Anxiety disorders	ADIS-C/P	Silverman & Albano, 1996	5
Anxiety symptoms	Spence Children's Anxiety Scale-child and parent report (SCAS)	Spence, 1998	3
Anxiety symptoms	Social Phobia Anxiety Inventory - child and parent report (SPAI)	Beidel et al., 2000	3
Anxiety interference	Child Anxiety Life Interference Scale – child and parent report (CALIS)	Lyneham et al., 2013	3

Recruitment

Children were recruited from a pool of children who had demonstrated poor reading and elevated levels of anxiety in a previous study (see Chapter 3). Parents of these children had indicated that they would be willing to be contacted about future studies. We sent information and consent forms (see Appendix A) to six parents whose children met the

reading criteria below, and also showed elevated anxiety symptoms on a parent-report questionnaire. Four of the parents responded that they would like to participate in the study.

Inclusion criteria

Children were eligible to participate in the study if they were aged 8 to 12 years and had poor word reading accuracy and anxiety. We identified poor word reading accuracy by performance that was at least one standard deviation (≤ 1 SD) below the mean for their age on the Nonword or Irregular Word lists of the Castles and Coltheart Reading Test, 2nd Edition (CC2; Castles et al., 2009; see “Recruitment measures” section below). We considered children to have significant anxiety if they met diagnostic criteria for one or more primary anxiety disorders as determined by a clinician severity rating (CSR) of 4 or more on the Anxiety Disorders Interview Schedule for Children and Parents (ADIS-C/P; Silverman & Albano, 1996; see “Recruitment measures”).

Exclusion criteria

Children with a history of severe behavioural issues, poor hearing, poor vision, neurological impairment, sensory impairment, or other developmental disorders (e.g., autism) – as measured with a parent-completed background questionnaire (see Appendix B) – were not included in the study because such problems could impair the effective delivery and reception of the Cool Reading treatment. Children were also excluded if they experienced severe emotional disorders other than anxiety (e.g., major depression disorder as detected by the ADIS-C/P; Silverman & Albano, 1996; see “Recruitment measures” section below) to maximise the chance that they would benefit from an intervention that focused on anxiety rather than other emotional health problems.

Recruitment measures (T1)

Word reading accuracy for irregular words and nonwords

To recruit poor readers, we used the Nonword and Irregular Word Lists of the Castles and Coltheart Reading Test 2 (CC2; Castles et al., 2009). To minimise repetition, we refer the reader to Chapter 3 for a detailed description of this measure.

Anxiety disorders

We used the parent (P) and child (C) Anxiety Disorders Interview Schedule (ADIS-C/P) for the Diagnostic and Statistical Manual for Mental Disorders 4th edition (DSM-IV) to ascertain whether a child met criteria for one or more anxiety disorders (Silverman & Albano, 1996). The clinician administers a series of questions pertaining to each anxiety disorder. Parents and children answer the questions in separate interviews. If the responses meet criteria for an anxiety disorder, the clinician asks the child and parent to rate the level of interference of the anxiety disorder. The clinician considers all the information from the parent and the child interviews and allocates a clinician severity rating (CSR) to the anxiety disorder. The CSR scores range from zero to eight and scores equal to or greater than four indicate a clinically severe and interfering anxiety disorder.

Research suggests that the ADIS-C/P has sound test-retest reliability for separation anxiety disorder ($\kappa = 0.84$), social anxiety disorder ($\kappa = 0.85$), specific phobia ($\kappa = 0.84$), and generalised anxiety disorder ($\kappa = 0.84$; Silverman, Saavedra, & Pina, 2001). Reliability of panic disorder and obsessive-compulsive disorder have not been reported because of the low occurrence of these anxiety disorders (Silverman et al., 2001).

In this study, the assessor (DF at T1; LM at T2) administered the ADIS-C/P to children in face-to-face interviews and to their parents in separate sessions either face-to-face or over the telephone. Previous research has found that telephone administered interviews show sound agreement with the face-to-face administered interviews (Lyneham & Rapee, 2005).

Sensory and neurological problems and other developmental disorders

A background questionnaire designed for this study was completed by parents when they returned the information and consent form (see Appendix B). The questionnaire obtained details on the child's developmental milestones (e.g., speech and language development), developmental disorders (e.g., autism), sensory impairments, neurological concerns, hearing impairments, visual difficulties, current diagnoses, qualitative information on their child's reading and spelling difficulties, emotional health difficulties, history of medication, history of previous intervention for reading, spelling, and anxiety, family history of reading and spelling problems and anxiety and depression, ethnicity, and sociodemographic details.

Profiling measures (T1)

We administered 10 measures to gain an approximate understanding of the children's profiles in terms of verbal and nonverbal cognitive ability, and the potential linking variables identified in Chapter 3 (reading self-concept, peer relations, attention, behaviour). These measures were not used to inform the inclusion or exclusion of children, or measure the outcomes of Cool Reading. As shown in Table 1, four profiling measures have been explained in previous chapters, so we refer the reader to the appropriate chapter to avoid repetition. Below we describe the profiling measures that have not been administered previously (e.g., peer relationships, inattention, hyperactivity, defiance and aggression, nonverbal cognitive ability, verbal cognitive ability).

Peer relationships

We used the peer relationships subscale of the Conners 3rd Edition Parent Report Questionnaire (Conners-P; Conners, 2008) to measure peer relationships. This subscale comprises five items (i.e., “is one of the last to be picked for teams or games”, “does not know how to make friends”, “has trouble keeping friends”, “has no friends”, “does not get invited to play or go out with others”). Parents rate how much each item applies to their child

(e.g., 0 = not true at all, 1 = just a little true, 2 = pretty much true, 3 = very much true). Raw scores are tallied and converted into *T*-scores ($M = 50$, $SD = 10$). Scores that are 1.5 SD above the population mean are considered elevated (i.e., at least 65). The internal consistency for the peer relationships subscale is sound ($\alpha = 0.85$) as is the test-retest reliability ($r = 0.93$; Gallant, Conners, Rzepa, Pikanen, Marocco, & Sitarenios, 2007)

Inattention

The inattention subscale of the Conners-P was used to measure problems with inattention (Conners, 2008). This subscale comprises six items (e.g., “doesn’t pay attention to details; “makes careless mistakes”; “has a short attention span”; “has trouble concentrating”; “inattentive, easily distracted”; “has trouble keeping his/her mind on work or play for long”). Parents rate how much each item applies to their child (e.g., 0 = not true at all, 1 = just a little true, 2 = pretty much true, 3 = very much true). Raw scores are tallied and converted into *T*-scores ($M = 50$, $SD = 10$). Scores that fall 1.5 SD above the population mean are considered elevated (i.e., at least 65). The inattention subscale has sound internal consistency ($\alpha = 0.93$) and test-retest reliability ($r = 0.80$; Gallant et al., 2007).

Hyperactivity

We used the hyperactivity subscale of the Conners-P to measure problems with hyperactivity (Conners, 2008). The subscale comprises six items (e.g., “restless/overactive”; “fidgets or squirms in seat”; “runs or climbs when he/she is not supposed to”; “acts as if driven by a motor”; “is constantly moving”; “excitable/impulsive”). Parents respond by rating how much each item applies to their child (e.g., 0 = not true at all, 1 = just a little true, 2 = pretty much true, 3 = very much true). Raw scores are tallied and converted into *T*-scores ($M = 50$, $SD = 10$), and scores 1.5 SD above the population mean are considered elevated

(i.e., at least 65). The hyperactivity subscale has sound internal consistency ($\alpha = 0.94$) and test-retest reliability ($r = 0.80$; Gallant et al., 2007).

Defiance and aggression

The defiance and aggression subscale from the Conners-P measures another aspect of poor behaviour (Conners, 2008). This subscale comprises five items (e.g., “starts fights with others on purpose”; “bullies, threatens or scares others”; “is angry and resentful”; “tells lies to hurt other people”; “threatens to hurt others”). Parents rate how much each item applies to their child (e.g., 0 = not true at all, 1 = just a little true, 2 = pretty much true, 3 = very much true). Raw scores are tallied and converted into *T*-scores ($M = 50$, $SD = 10$). Scores 1.5 SD above the population mean are considered elevated (i.e., at least 65). The defiance and aggression subscale has sound internal consistency ($\alpha = 0.91$) and test-retest reliability ($r = 0.70$; Gallant et al., 2008).

Nonverbal cognitive ability

The Kaufman Brief Intelligence Test 2nd Edition (KBIT-2; Kaufman & Kaufman, 2004) is an intelligence test that measures verbal and nonverbal cognitive skills. The matrices subtest measures nonverbal skills and comprises 46 picture or pattern items. Children are presented with a target picture or pattern and instructed to point to the matching picture or pattern. Children are provided 30 seconds to respond, after which the item is scored as incorrect. The clinician records the child’s responses as correct “1” or incorrect “0”. A child’s nonverbal cognitive skill basal level also needs to be established, and items are administered in reverse order until three consecutive items are answered correctly. The test is discontinued after four consecutive incorrect scores. The total score is out of 46 and is calculated by tallying the correct responses. Raw scores are converted into standard scores (SS; $M = 100$, $SD = 15$) based on a child’s age. Scaled scores are interpreted as below average (i.e., below 85), average (from 85 to 115), or above average (above 115). The matrices subtest has sound

split half reliability ($r = 0.91$) and reliable concurrent validity with the Wechsler Abbreviated Scale of Intelligence. The test-retest reliability over a 28-day interval is also sound ($r = 0.76$; Kaufman & Kaufman, 2004).

Verbal cognitive ability

The recalling sentences subtest of the Clinical Evaluation of Language Fundamentals 4th Edition (CELF-4; Semel, Wiig, & Secord, 2003) measures a child's ability to recall and reproduce sentences. The child is instructed to repeat pre-recorded sentences of increasing length and complexity (i.e., Item 1: "The tractor was followed by the bus"; Item 23: "The coach gave the trophy to the team that won the athletics carnival on Saturday"). This subtest comprises two practice sentences and 32 test sentences. Each sentence is presented only once. The clinician records the child's response verbatim and marks any errors. Errors are marked as omissions (i.e., word or part of a word that is omitted), repetitions (i.e., repeated words), additions (i.e., addition of a word or words), transpositions (i.e., transposed words), and substitutions (i.e., words that are omitted and substituted). The clinician scores each sentence according to the number of errors per sentence (zero errors = 3; one error = 2; two or three errors = 1; four or more errors = 0). A child's basal verbal cognitive level is also to be established. If any errors are made on the first three sentences, the items are administered in reverse order until three consecutive correct responses are recorded. The test is discontinued after five consecutive incorrect responses.

The total raw score is calculated by tallying the scores. Raw scores are then converted into scaled scores ($M = 10$, $SD = 3$). In terms of cut-off criteria, a scaled score 7 or lower indicates poor verbal cognitive ability, a score from 8 to 12 indicates average verbal cognitive ability, and a score 13 or higher indicates high verbal cognitive ability. There are Australian based norms for the CELF-4 and Cronbach's alpha reliability coefficients for the recalling sentences subtest are sound ($\alpha = 0.86$ to 0.93 ; Semel et al., 2003).

Reading outcome measures (T1 and T2)

At T1 and T2, we administered tests to assess general reading skills (word reading accuracy, text reading accuracy, word reading fluency, text reading fluency, reading comprehension), the nonlexical reading route (nonword reading accuracy, nonword reading fluency, nonword spelling), the lexical reading route (irregular word reading accuracy, irregular word spelling), individual components of the two reading routes (letter identification, GPC knowledge for individual graphemes, GPC knowledge for nonword reading, GPC knowledge for nonword spelling, the orthographic lexicon, and the link between orthography and semantics). As shown in Table 1, some of these tests have already been described in Chapter 3 (reading accuracy for regular words, word reading fluency, text reading fluency, reading comprehension, nonword reading accuracy, nonword reading fluency, nonword spelling, irregular word reading accuracy, irregular word spelling). Below we outline the measures that have not yet been discussed that we used to index the effect of Cool Reading on reading outcomes.

General reading

Text reading comprehension. The Neale Analysis of Reading Ability (NARA) measures both text reading accuracy and comprehension (Neale, 1999). A child is presented with up to six text passages that increase in length and complexity. The child is instructed to read each passage aloud, attempt any words they are unsure of, and remember the passage as they read it. The clinician follows along with the child and corrects inaccurate reading. The clinician asks the comprehension questions for the assigned passage as soon as the child has finished reading the passage. The NARA has a basal rule of no more than two accuracy errors on the starting passage. If more than two errors are made then the child is instructed to read the previous level until basal is reached. A discontinue rule is applied when the child makes

more than 16 errors on passages one to four, or more than 20 errors on passages five or six. If this error rate is exceeded then the comprehension questions are not administered.

Reading comprehension scores are calculated by tallying the number of correctly answered questions per passage. Raw scores are tallied and converted into stanine scores ($M = 5$, $SD = 2$). A stanine score below 4 indicates poor reading comprehension, a score from 4 to 6 indicates average reading comprehension, and a score higher than 6 indicates high reading comprehension. The psychometric properties for the NARA are strong ($\alpha = 0.93$), as is the test-retest estimate over an 8 week retest period ($r = 0.93$; Neale, 1999).

Text reading fluency. The Wheldall Assessment of Reading Passages (WARP; Wheldall & Madeleine, 2000) measures text reading fluency using three passages of text that each comprise approximately 200 words. This test requires children to read as much of the passage as possible, both quickly and accurately, in 1 minute. The clinician records the child's errors verbatim and tallies the number of words read correctly per minute (WCPM). There are no standard scores available for this test. However, a raw WCPM score can be compared to cut-off scores (e.g., lowest 25%) calculated for the child's grade level (e.g., Year 3 Term 4 = 73 WCPM; Year 4 Term 4 = 98 WCPM; Grade 5 Term 4 = 110 WCPM). Test-retest reliability estimates for the WARP are high ($r = 0.96$; Wheldall & Madeleine, 2000). The WARP is also strongly correlated with the Test of Everyday Reading Comprehension (TERC; $r = 0.71$; Wheldall & McMurtry, 2014).

Individual components of the nonlexical and lexical reading routes

Letter identification. The cross-case copying task measures letter identification (McArthur et al., 2013). The test comprises 14 items. The child is shown a letter in either upper case (e.g., M) or lowercase (e.g., y) and is asked to write the letters corresponding lowercase (e.g., M \rightarrow m) or uppercase (e.g., y \rightarrow Y) letter. The child completes the 14 questions in their own time and the clinician marks their responses (i.e., correct = 1; incorrect

= 0). Scores are tallied as raw scores. This is not a normed test and there are currently no psychometric or test-retest reliability estimates available for this test.

GPC knowledge (graphemes). The Letter-Sound Test (LeST; Larsen, Kohnen, Nickels, & McArthur, 2015) measures GPC knowledge for individual graphemes. In this test, children are presented with 51 individual graphemes and asked to say the sound that the letter(s) make. If the child responds with the letter name (i.e., “E” for /e/) the clinician prompts the child with “that is the letter name, what sound does that letter make?” The clinician records the child’s responses verbatim and scores correct responses as “1” and incorrect responses as “0”. The total number of correct scores are tallied and converted to *z*-scores ($M = 0$; $SD = 1$). In terms of cut-off criteria, a *z*-score below -1.00 indicates poor GPC knowledge for graphemes, a *z*-score from -1.00 to 1.00 indicates average GPC knowledge, and a *z*-score higher than 1.00 indicates high GPC knowledge. Normative data is only available for children in Grades K to 3. The psychometric properties show sound intraclass correlations ($ICC = 0.88$; $p < .001$) and test-retest reliability after an 8-week period ($r = 0.84$; Larsen et al., 2015).

GPC knowledge (nonword reading). The Diagnostic Reading Test (DiRT; Colenbrander, Kohnen, & Nickels, 2011) measures GPC knowledge for words using a nonword reading task. The DiRT comprises 61 nonwords (e.g., coom, wib). The child is instructed to read each nonword aloud and the nonwords are presented on individual flashcards. The clinician records the child’s responses verbatim. Correct responses are allocated a score of “1” and incorrect responses a score of “0”. Raw scores are tallied out of a total maximum raw score of 61. The DiRT is an error-based test and no normative or test-retest data are available.

PGC knowledge (nonword spelling). The Diagnostic Nonword Spelling Test (DiSTn; Kohnen, Nickels, & Castles, 2009) measures PGC knowledge within the context of

nonword spelling. The DiSTn comprised 46 nonwords that assess knowledge phoneme-to-grapheme correspondences (PGCs; e.g., buv, gib). The clinician reads aloud each nonword to the child and the child is asked to repeat the nonword and write down the nonword.

Responses are scored as correct “1” and incorrect “0”. Raw scores are tallied out of a possible maximum score of 46. The DiSTn is an error-based test and no normative data or test-retest estimates are available.

Orthographic lexicon. The Test of Orthographic Choice (TOC; Kohnen, Anandakumar, McArthur, & Castles, 2012) measures written word recognition and is a test of the orthographic lexicon. The TOC comprises 30 written items that sound the same when read using GPC rules (i.e., cloak cloke). The child is instructed to circle the word in a word pair that is spelled correctly. The clinician marks the child’s responses as correct “1” and incorrect “0”. The raw scores are tallied out of possible score of 30, and converted into *z*-scores ($M = 0$, $SD = 1$). In terms of cut-off criteria, a *z*-score below -1.00 indicates poor performance, a *z*-score from -1.00 to 1.00 indicates average performance, and a *z*-score above 1.00 indicates high performance. Normative data were based on children from two schools in Sydney, Australia, who performed within the average range on national measures of literacy. The TOC has also shown sound test-retest reliability after an 8-week period ($r = 0.57$).

Orthographic-semantics link. The Meaning of Written Words Test (MeOWW; Kohnen, Larsen, Jones, Castles, & McArthur, 2012) measures the ability to access semantic information from orthography. The MeOWW presents word pairs to children that are either homophones (i.e., words that sound the same but are spelled differently; son/sun) or potentiophones (i.e., words that when sounded out sound the same as another word; love/loave). Children are shown word pairs printed on the page (e.g., loves vs. loaves). One of these items is printed in a circle (loves) and the other in a square (loaves). The child has a response sheet with squares and circles. The clinician reads aloud a clue to the child (e.g.,

there are lots of these in a bakery) and the child determines whether the correct answer is in the circle (incorrect) or square (correct). Correct responses are scored as “1” and incorrect responses as “0”. Correct scores are tallied out of a maximum raw score of 40. The score is then evaluated against a critically low score to determine below average performance. At present, no psychometric properties have been reported for this test.

Anxiety outcome measures (T1 and T2)

At T1 and T2, we administered tests to assess anxiety disorders, anxiety symptoms, and anxiety interference. As shown in Table 1, five of the anxiety outcome measures have been described in previous chapters (SCAS-C; SCAS-P; SPAI-C; SPAI-P). Below we focus on tests that have not yet been outlined.

Anxiety interference

We measured anxiety interference using the Child Anxiety Life Interference Scale (i.e., child report: CALIS-C; parent report: CALIS-P; Lyneham et al., 2013). The subscales include interference at home (i.e., how much does anxiety interfere with family life), interference outside of home (i.e., how much does anxiety interfere with performance in the classroom), and interference on parent life (i.e., how much does anxiety interfere with your everyday life – CALIS-P only). Parents and children rate how much anxiety interferes with life at home, outside home, and parent life (parents only; i.e., 0 = not at all, 1 = only a little, 2 = sometimes, 3 = quite a lot, 4 = a great deal). Raw scores are tallied and compared to clinical group means for the child report CALIS-C (i.e., at home interference: $M = 1.40$, $SD = 1.40$; outside home interference: $M = 0.55$, $SD = 0.80$) and the mother report CALIS-P (i.e., at home interference: $M = 1.38$, $SD = 1.20$; outside home: $M = 1.10$, $SD = 2.00$; parental interference: $M = 3.23$, $SD = 3.30$). Scores equal to or greater than the clinical population mean are considered elevated. The CALIS-C has sound internal consistency for at home interference ($\alpha = 0.70$) and outside home interference ($\alpha = 0.82$; Lyneham et al., 2013). The

CALIS-P also has sound internal consistency for at home interference ($\alpha = 0.78$), outside home interference ($\alpha = 0.82$), and parent life ($\alpha = 0.87$). Test-retest effects based on an 8 to 9 week no treatment period are sound for mother ($r = 0.63$) and child ($r = 0.67$) at home interference, mother ($r = 0.66$) and child ($r = 0.62$) outside home interference, and mother report of parent life interference ($r = 0.74$; Lyneham et al., 2013).

Cool Reading treatment

Reading

Chapter 4 outlined the evidence for the Cool Reading treatment components. All children in this study received word accuracy reading treatment. Thus, we selected the following Cool Reading treatment components for reading: MURC Reading Gap intervention program (Kohnen & Banales, 2015a), MURC Spelling Gap intervention program (Kohnen & Banales, 2015b), MURC Sight Words intervention program for reading and MURC Sight Words intervention program for spelling (Kohnen & Banales, 2015c), and MURC Text Reading Accuracy Training.

The five reading treatments directly trained regular reading accuracy, nonword reading accuracy, nonword spelling, GPC knowledge, irregular word reading, and irregular word spelling. The reading treatment components indirectly trained letter identification. No child received direct or indirect training for reading fluency, reading comprehension, or the orthographic-semantics link. Tables 4 to 7 in the “Results” section compare the types of reading treatment received by each child to their reading outcomes from T1 to T2.

Anxiety

The core and specific anxiety treatment components of Cool Reading have already been described in Chapter 4. All children were administered the core anxiety treatment components of Cool Reading. No children completed the specific treatment components (i.e., Structured Problem Solving, Progressive Muscle Relaxation, Social Skills and Confidence,

Dealing with Bullying) as they were not required for any of the children. Tables 8 to 12 compare the types of anxiety treatment received by each child to their anxiety outcomes from T1 to T2.

RESULTS

Below, we report the results of the measures used for profiling children in two stages. First, we consider the outcomes of the four children as a group, and then we describe the individual profiles of each child. After this, we present an analysis of the T1 and T2 scores for the reading (general reading skills, nonlexical reading route, lexical reading route, individual components of routes) and anxiety outcomes (anxiety disorders, anxiety symptoms, anxiety interference). For the outcome measures, we report raw scores at T1 and T2 because they are more sensitive to change than standard, scaled, or z-scores. We also report the anxiety results from the parent-report questionnaire since research suggests that anxious children tend to underreport their anxiety symptoms compared to parents (Schniering, Hudson, & Rapee, 2000). We report the child report questionnaire data in Appendix C (Note: In line with Schniering and colleagues (2002), children reported fewer anxiety symptoms than their parents).

Profiles

Group profile

Four boys met the criteria for inclusion in this study: CS, AC, BK, RC. Table 2 provides the standardised scores (nonword and irregular word reading accuracy) and diagnostic raw scores (anxiety disorders) on the recruitment measures for these four children. In terms of reading, as a group, CS, BK, AC, and RC presented with mixed reading difficulties. Three children performed more than 1 SD below average for nonword reading accuracy (CS, AC, RC) while one child performed less than 1 SD below average (BK). Three

children performed more than 1 SD below average for irregular word reading accuracy (AC, BK, RC) and one child performed less than 1 SD below average (CS).

In terms of anxiety, two children received a primary diagnosis of social anxiety disorder (AC, BK), and two children received a primary diagnosis of generalised anxiety disorder (CS, RC). Considered together, all children were diagnosed with social anxiety and generalised anxiety disorder, and three children were diagnosed with separation anxiety disorder (CS, AC, BK). All children were diagnosed with one or more specific phobias (natural environment type: CS, AC, BK, RC; blood injury type: CS). All children reported significant and interfering school related worries (e.g., reading aloud, taking tests, asking questions, asking for help, writing on the board).

Table 2
Children's scores at T1 on the recruitment measures

	CS	AC	BK	RC
Reading accuracy				
Nonword reading accuracy ^a (CC2; z-scores)	-1.30	-1.92	-0.73	-1.30
Irregular reading accuracy ^a (CC2; z-scores)	-0.80	-2.17	-2.07	-1.02
Anxiety Disorders				
Generalised anxiety disorder (ADIS-C/P; CSR) ^b	6	6	6	5
Separation anxiety disorder (ADIS-C/P; CSR) ^b	6	6	5	ND
Social anxiety disorder (ADIS-C/P; CSR) ^b	5	6	6	4
Specific phobia – Blood injury (ADIS-C/P; CSR) ^b	4	ND	ND	ND
Specific phobia – Natural environment type (ADIS-C/P; CSR) ^b	5	4	5	4

Note. Bolded scores are 1 SD below average (reading) or above the clinical threshold (anxiety disorders).

^aLow scores indicate poor performance ^bHigh scores indicate poor performance. ND = not diagnosed. Grey cells indicate primary disorder.

Children's performance on the linking variables is shown in Table 3. As a group, three children performed more than 1 SD below average for reading self-concept (CS, BK, RC) and one child performed in the average range (AC). One child was had poor peer relations

(CS), while all other children had average peer relations (AC, BK, RC). All children reported hyperactivity problems and combined hyperactivity and inattention problems. Three children reported inattention problems (CS, AC, RC), while one child performed within the average range (BK). Two children were elevated for defiance and aggression (CS, AC), while two children reported no behavioural problems (BK, RC). Three children had nonverbal cognitive skills in the average range (AC, BK, RC) and one child performed less than 1 SD below average (CS). Three children had verbal cognitive skills in the average range (CS, BK, RC) and one child performed less than 1 SD below average (AC).

Table 3
Children's scores on the profiling measures at T1

	CS	AC	BK	RC
Reading self-concept measure				
Reading self-concept (RSCS; raw scores ≤ 3.18) ^a	2.43	3.73	2.63	3.16
Peer relations measures				
Peer problems (SDQ-P; raw scores ≥ 3.5) ^b	4	1	1	0
Peer relationships (Conners-P; <i>T</i> -scores ≥ 65) ^b	52	45	60	44
Attention measures				
Inattention (Conners-P; <i>T</i> -scores ≥ 65) ^b	88	65	59	90
Hyperactivity (Conners-P; <i>T</i> -scores ≥ 65) ^b	89	76	79	76
Hyperactivity & inattention (SDQ-P; raw scores ≥ 5.5) ^b	6	8	7	10
Behaviour measures				
Conduct symptoms (SDQ-P/raw scores ≥ 3.1) ^b	0	2	1	0
Defiance and aggression (Conners-P/ <i>T</i> -scores ≥ 65) ^b	70	90	46	45
Verbal and nonverbal cognitive ability				
Verbal cognitive ability (CELF-4; scaled scores ≤ 7) ^a	10	7	11	8
Nonverbal cognitive ability (KBIT-2; standard scores ≤ 85) ^a	91	111	101	123

Note. ^aLow scores indicate poor performance. ^bHigh scores indicate poor performance. Bolded scores are clinically elevated according to cut-off scores which are listed in the first column.

Individual profiles

CS. CS completed his T1 assessment in February, 2018. CS was 11 years and 5 months in age, and attended Grade 6 (Term 1) at a public school in Sydney. At T1, CS presented with mixed reading difficulties and a predominant phonological decoding difficulty. He performed more than 1 SD below the average range on the test of nonword reading accuracy, and within the average range for irregular word reading accuracy. In terms

of anxiety, his primary diagnosis was generalised anxiety disorder. He also met diagnostic criteria for social anxiety disorder, separation anxiety disorder, specific phobia – blood injury type, and specific phobia – natural environment type. The most interfering worries included school performance, asking questions in the classroom, reading aloud, asking for help, and taking tests. CS also experienced physical symptoms such as headaches and nausea. These difficulties occurred within the context of average nonverbal and verbal cognitive ability, poor reading self-concept, elevated peer problems, inattention problems, hyperactivity problems, and defiance and aggression (see Table 3 scores on the profiling measures). In terms of previous intervention, CS had received reading treatment but no treatment for anxiety. CS did not receive any external intervention for reading or anxiety during the study.

AC. AC completed the T1 assessment in February 2018. He was 10 years and 7 months in age, and in Grade 5 (Term 1) at a Catholic school in Sydney. In terms of reading, AC presented with mixed reading difficulties. For the tests of reading accuracy, AC performed more than 1 SD below average for both nonword and irregular reading accuracy. In terms of anxiety, his primary diagnosis was social anxiety disorder. AC also met diagnostic criteria for generalised anxiety disorder, separation anxiety disorder, and specific phobia – natural environment type. AC's most interfering worries related to school (e.g., getting into trouble, asking for help in the classroom, reading aloud, taking tests, homework) and separation anxiety disorder (e.g., being away from his family and being alone). These difficulties fell within the context of poor inattention, hyperactivity, hyperactivity/inattention, and behaviour problems, and below average verbal cognitive skills. He showed age-appropriate nonverbal cognitive skills, reading self-concept, and peer relations. In terms of previous intervention, AC's mother reported that he had participated in a number of different reading interventions but had not received treatment for anxiety. He did not receive any external treatment for reading or anxiety throughout this study.

BK. BK completed the T1 assessment in February, 2018, when he was aged 9 years and 11 months. BK had just commenced home school due to his reading difficulties and inability to access the school curriculum. BK presented with mixed reading difficulties. For the tests of reading accuracy, BK performed more than 1 SD below average on irregular word reading accuracy and less than 1 SD below average for nonword reading accuracy. In terms of anxiety, his primary diagnosis was social anxiety disorder. BK also met diagnostic criteria for generalised anxiety disorder, separation anxiety disorder, and specific phobia – natural environment type. BK’s most interfering worries were related to social anxiety disorder (e.g., meeting new people, interacting with groups of children or unfamiliar people) and separation anxiety disorder (e.g., being alone). BK also reported that school-related worries (e.g., reading aloud, taking tests, spelling, asking questions, asking for help in the classroom) contributed to substantial anxiety when he attended mainstream school which resulted in school refusal and numerous absences. These difficulties occurred within the context of hyperactivity and inattention problems, and poor reading self-concept. He had age appropriate nonverbal cognitive skills, verbal cognitive skills, peer relations, inattention, and behaviour. BK had previously been assessed for anxiety and poor reading. He had received previous treatment for reading and anxiety. BK did not receive any additional treatment for reading or anxiety during this study.

RC. RC completed the T1 assessment in February 2018 when he was aged 11 years and 6 months. He attended a public school in Sydney (Grade 6 in Term 1). RC’s reading difficulties were consistent with a mixed reading profile. For the tests of reading accuracy, RC performed more than 1 SD below average for nonword and irregular reading accuracy. In terms of anxiety, his primary diagnosis was generalised anxiety disorder. RC also met diagnostic criteria for social anxiety disorder and specific phobia - natural environment type. RC reported a number of interfering and distressing worries related to school (e.g., reading

aloud, delivering a speech to the class, asking for help and asking questions in the classroom, trying new things). These difficulties fell within the context of poor reading self-concept, inattention, hyperactivity, and hyperactivity/inattention problems, and age appropriate nonverbal cognitive skills, verbal cognitive skills, peer relations, and behaviour. RC had not received previous treatment for reading or anxiety. He did not receive any additional treatment outside that provided by this study.

Cool Reading outcomes

Data analysis

In this pilot study, we calculated reliable change index (RCI) scores to determine whether there was a statistically significant change in any outcome scores from T1 to T2 (Jacobson & Truax, 1991). To calculate each RCI, we followed the methods prescribed by Jacobson and Traux. First, we obtained the test-retest reliability coefficients (r_{11}) and standard deviations (SD) of the population normative data for each outcome measure. Second, we calculated the standard error of measurement (SEM) for each measure ($SEM = SD * \sqrt{1-r_{11}}$). Third, we calculated the RCI (standardised z -score) by dividing the difference between T1 and T2 raw scores by the standard error of the difference between the two scores. If the difference score was greater than or equal to the RCI, (reported in Tables 4 to 12 for each relevant outcome measure), then the amount of change between the T1 and T2 scores for an outcome measure was not attributed to the unreliability of the measure (i.e., was considered reliable). The RCI calculation has been used in numerous intervention studies to determine clinically meaningful and significant change (e.g., Duff, 2012; Rozenman, Weersing, Amir, 2011; Spence et al., 2008).

RCIs can only be calculated for outcome measures with reported test-retest reliability coefficients. For the reading outcomes, we were able to obtain these coefficients for four general reading outcomes (regular reading accuracy, word reading fluency, text reading

fluency, reading comprehension), three nonlexical reading route outcomes (nonword reading accuracy, nonword reading fluency, nonword spelling), two lexical route outcomes (irregular reading accuracy, irregular word spelling), and two individual components outcomes (GPC knowledge for graphemes, orthographic lexicon). For anxiety outcomes, we calculated RCIs for six anxiety symptom outcomes (social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms, physical injury fears, panic/agoraphobia symptoms, obsessive-compulsive symptoms), and the anxiety interference outcomes (home interference, outside home interference, parent life interference).

This left four reading outcomes (letter identification, GPC knowledge for nonword reading, PGC knowledge for nonword spelling, orthographic-semantics link) and six anxiety disorder outcomes (social anxiety disorder, separation anxiety disorder, generalised anxiety disorder, specific phobias, panic disorder, obsessive-compulsive disorder) and one anxiety symptom outcome (social anxiety symptoms) without RCI scores. For the anxiety disorder outcomes, we explored the efficacy of Cool Reading via remission rates, which were calculated by comparing the T1 and T2 anxiety disorder raw scores to a clinical cut-off score to identify the percentage of children who shifted from above the clinical threshold (i.e., a CSR equal to or above 4) prior to treatment to below the clinical threshold after treatment (i.e., a CSR below 4; see Tables 8 to 10). For the remaining four reading outcomes and one anxiety outcome, we simply calculated raw score difference scores and interpreted them with extreme caution. The results for each of the reading and anxiety outcomes are discussed in turn below.

Reading outcomes

General reading. The raw scores, difference scores, and the RCIs for the general reading outcome measures are shown in Table 4. This table also indicates if each child received training for skills that are indexed by each measure. CS showed a statistically

significant improvement for reading comprehension. He showed non-significant raw score improvement for regular reading accuracy and word reading fluency. He showed a non-significant raw score reduction for text reading fluency. AC showed significant improvements for regular reading accuracy and word reading fluency, and non-significant raw score improvements for text reading fluency. He showed a non-significant raw score reduction for reading comprehension. BK showed significant raw score improvements for text reading fluency and reading comprehension. He showed non-significant raw score improvements for regular reading accuracy, and word reading fluency. RC showed significant improvements for regular reading accuracy and reading comprehension. He showed non-significant raw score improvements for word reading fluency, and text reading fluency.

In sum, all children were trained for word reading accuracy but not reading fluency or reading comprehension. Aligned with this, two children showed significant improvements for regular reading accuracy (AC, RC). In addition, three children showed significant improvements for reading comprehension (CS, BK, RC), and one individual showed significant improvements for word reading fluency (AC) or text reading fluency (BK).

Table 4

Raw scores and reliable change index (RCI) results for general reading outcomes, with an indication of whether each outcome was trained during treatment

Outcome measure		CS	AC	BK	RC
Regular word reading accuracy (CC2; raw scores /40)	T1	36	12	32	32
	T2	37	19	34	36
	Difference	1	7	2	4
	RCI	2.56	4.11	5.50	2.56
	Trained	✓	✓	✓	✓
Word reading fluency (TOWRE; raw scores /104)	T1	56	22	30	61
	T2	60	33	38	66
	Difference	4	11	8	5
	RCI	9.02	8.60	9.54	9.02
	Trained	X	X	X	X
Text reading fluency (WARP; raw scores /200)	T1	105	24	30	114
	T2	104	32	47	126
	Difference	1	8	17	12
	RCI	16.18	20.35	16.85	16.18

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	Trained	X	X	X	X
Reading comprehension (NARA; raw scores /44)	T1	22	10	11	23
	T2	30	9	17	35
	Difference	8	-1	6	12
	RCI	6.23	6.13	5.95	6.23
	Trained	X	X	X	X

Note. Reliable changes are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Nonlexical reading route. The raw scores, difference scores, and the RCIs for the nonlexical reading route outcome measures are shown in Table 5. CS showed significant raw score improvements for nonword reading accuracy, and non-significant raw score improvements for nonword reading fluency and nonword spelling. AC showed a significant raw score improvement for nonword reading fluency, and a non-significant raw score improvement for nonword spelling. He showed a non-significant raw score reduction for nonword reading accuracy. BK showed a significant improvement for nonword spelling and non-significant raw score improvements for nonword reading accuracy and fluency. RC showed significant improvements for nonword reading accuracy and nonword reading fluency. He showed a non-significant raw score improvement for nonword spelling.

In sum, all children were trained for nonword reading accuracy and spelling but not nonword reading fluency. In line with this, two children showed significant improvements for nonword reading accuracy (CS, RC), and one child showed a significant improvement for nonword spelling (BK). In addition, two children showed significant improvements for nonword reading fluency (AC, RC).

Table 5

Raw scores and reliable change index (RCI) results for general nonlexical reading route outcomes, with an indication of whether each outcome was trained during treatment

Outcome measure	Test	CS	AC	BK	RC
Nonword reading accuracy (CC2; raw scores /40)	T1	21	9	24	21
	T2	33	6	32	31
	Difference	12	-3	8	10

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	RCI	7.07	11.40	13.51	7.07
	Trained	✓	✓	✓	✓
Nonword reading fluency (TOWRE; raw scores /63)	T1	28	5	17	19
	T2	32	17	21	36
	Difference	4	12	4	17
	RCI	10.56	10.56	10.31	10.56
	Trained	X	X	X	X
Nonword spelling (QUIL; raw scores /40)	T1	8	3	7	8
	T2	12	5	15	15
	Difference	4	2	8	7
	RCI	7.08	7.58	4.88	7.08
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. Low scores indicate poor performance for all tests. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Lexical reading route. The raw scores, difference scores, and the RCIs for the lexical reading route outcome measures are shown in Table 6. CS showed non-significant raw score improvements for irregular word spelling and irregular reading accuracy. AC showed a non-significant raw score improvement for irregular reading accuracy and a raw score reduction for irregular word spelling. BK showed a significant raw score improvement for irregular word spelling and a non-significant raw score improvement for irregular reading accuracy. RC also showed a significant raw score improvement for irregular word spelling and no change for irregular reading accuracy.

In sum, all children were trained for reading and spelling irregular words and sight words. In line with sight word spelling training, two children showed statistically significant improvements for irregular word spelling (BK, RC).

Table 6
Raw scores and reliable change index (RCI) results for general lexical reading route outcomes, with an indication of whether each outcome was trained during treatment

Outcome measure	Test	CS	AC	BK	RC
Irregular reading accuracy (CC2; raw scores /40)	T1	22	8	12	20
	T2	23	9	13	20
	Difference	1	1	1	0
	RCI	4.87	5.60	5.60	4.87
	Trained	✓	✓	✓	✓
Irregular word spelling (DiSTi; raw scores /74)	T1	29	10	7	26
	T2	32	9	18	35
	Difference	3	-1	11	9
	RCI	8.86	8.81	7.37	8.86
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. Low scores indicate poor performance for all tests. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Individual components of the nonlexical and lexical reading routes. The raw scores, difference scores, and the RCIs for the individual component outcome measures are shown in Table 7 (Note: RCIs were not calculated for letter identification, GPC knowledge for nonword reading, nonword spelling, or the orthographic-semantics link as there are no test-retest reliability estimates available for these measure). CS showed raw score improvements for GPC knowledge of individual graphemes (non-significant), nonword reading, and nonword spelling. He showed no change in scores for letter identification, the test of the orthographic lexicon, or the test of the orthographic-semantics link. AC showed raw score improvements for GPC knowledge of individual graphemes (significant), GPC knowledge for nonword reading, GPC knowledge for nonword spelling, and the test of the orthographic-semantics link. He showed no change for letter identification. He showed a reduction in raw scores on the test of the orthographic lexicon (non-significant). BK showed raw score improvements for GPC knowledge of individual graphemes (non-significant), GPC knowledge for nonword reading, GPC knowledge for nonword spelling, and written word recognition. He showed no change in raw scores for letter identification and the test of orthographic and semantics link. RC showed raw score improvements for GPC knowledge of individual graphemes (significant), GPC knowledge for nonword reading, and GPC knowledge for nonword spelling. He showed no change for letter identification or written word recognition, and a raw score reduction for the test of the orthographic and semantics link (non-significant).

In sum, all children received training in reading and spelling GPCs individually or within nonwords, and sight word or irregular word training that should have impacted the

orthographic lexicon. The results showed that overall, two children showed significant improvements for GPC knowledge of individual graphemes (AC, RC).

Table 7

Raw scores and reliable change index (RCI) results for the components of the nonlexical and lexical reading routes, with an indication of whether each outcome was trained during treatment

	Test	CS	AC	BK	RC
Letter identification (CCC; raw scores /14)	T1	14	14	14	14
	T2	14	14	14	14
	Difference	0	0	0	0
	RCI	-	-	-	-
	Trained (indirect)	✓	✓	✓	✓
GPC knowledge for graphemes (LeST; raw scores /51)	T1	46	35	46	32
	T2	51	46	51	51
	Difference	5	11	5	19
	RCI	5.51	5.51	5.51	5.51
	Trained	✓	✓	✓	✓
GPC knowledge for nonword reading (DiRT; raw scores /71)	T1	25	10	43	29
	T2	66	36	63	62
	Difference	41	26	20	33
	RCI	-	-	-	-
	Trained	✓	✓	✓	✓
PGC knowledge for nonword spelling (DiSTn; raw scores /46)	T1	22	9	24	10
	T2	32	12	38	37
	Difference	10	3	14	27
	RCI	-	-	-	-
	Trained	✓	✓	✓	✓
Orthographic lexicon (TOC; raw scores /30)	T1	27	19	22	27
	T2	27	18	23	27
	Difference	0	-1	1	0
	RCI	5.45	5.81	6.90	5.45
	Trained	✓	✓	✓	✓
Orthographic-semantics link (MeOWW; raw scores /40)	T1	37	28	29	35
	T2	37	33	29	34
	Difference	0	5	0	-1
	RCI	-	-	-	-
	Trained	X	X	X	X

Note. Reliable changes are bolded. – indicates that the RCI was not calculated. Low scores indicate poor performance for all tests. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Anxiety outcomes

Anxiety disorders. The remission rates for children are shown in Table 8, and the raw scores on the outcome measure for anxiety disorders are shown in Table 9. In terms of remission rates, primary anxiety disorders and all anxiety disorders were not remitted for any children after the intervention (e.g., remission rate for primary anxiety diagnoses and all

anxiety diagnoses were 0%). Given these low remission rates, we also examined remission of individual anxiety diagnoses across the sample which showed an overall remission of 33% for all anxiety disorders. For CS, the diagnoses of separation anxiety disorder and social anxiety disorder remitted (i.e., CSR below 4). He showed a raw score reduction in clinical severity (CSR) for generalised anxiety disorder and no change for specific phobia. For AC, the diagnoses of separation anxiety disorder and specific phobia remitted. He showed a raw score reduction in clinical severity for generalised anxiety disorder and social anxiety disorder. BK continued to meet criteria for all anxiety disorders present prior treatment. He showed a raw score reduction in clinical severity for social anxiety disorder and specific phobia. For RC, social anxiety disorder and specific phobia remitted. He showed a raw score reduction in clinical severity for generalised anxiety.

In sum, all children received anxiety treatment for one or more problems with social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, and specific phobias. The results showed that primary anxiety disorders and all anxiety disorders were not remitted for any children. However, there was an overall remission rate of individual anxiety disorders of 33%. Individually, social anxiety disorder remitted for two children (CS, RC), separation anxiety disorder remitted for two children (CS, AC), and specific phobias remitted for two children (AC, RC). Generalised anxiety disorder did not remit for any children.

Table 8
Proportion of children no longer meeting criteria for each anxiety diagnoses

Disorder	Free from diagnosis	
	<i>n</i>	%
Primary diagnoses	0 / 4	0%
All anxiety diagnoses	0 / 4	0%
Social anxiety disorder	2 / 4	50%
Generalised anxiety disorder	0 / 4	0%
Separation anxiety disorder	2 / 3	66%
Specific phobia	2 / 6	33%
Total	6 / 18	33%

Note. Remission rates are determined based on the number of diagnoses assigned and some children had more than one diagnoses of specific phobia.

Table 9

Raw scores for anxiety disorders outcomes, with an indication of whether each outcome was trained during treatment

Outcome measure	Test	CS CSR	AC CSR	BK CSR	RC CSR
Social anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	5	6	6	4
	T2	2	4	5	3
	Difference	-3	-2	-1	-1
	Trained	✓	✓	✓	✓
Generalised anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	6	6	6	5
	T2	4	4	6	4
	Difference	-2	-2	0	-1
	Trained	✓	✓	✓	✓
Separation anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	6	6	5	ND
	T2	2	3	5	ND
	Difference	-4	-1	0	ND
	Trained	✓	✓	✓	X
Specific phobia – Blood injury type (ADIS-C/P; CSR raw scores / 8)	T1	4	ND	ND	ND
	T2	5	ND	ND	ND
	Difference	1	ND	ND	ND
	Trained	✓	X	X	X
Specific phobia – Natural environment type (ADIS-C/P; CSR raw scores / 8)	T1	5	4	5	4
	T2	5	3	4	2
	Difference	0	-1	-1	-2
	Trained	✓	✓	✓	✓
Specific phobia – Animal Type (ADIS-C/P; CSR raw scores / 8)	T1	ND	3	ND	ND
	T2	ND	4	4	ND
	Difference	ND	1	4	ND
	Trained	X	✓	✓	X

Note. Scores falling below the clinical threshold at T2 are bolded. ND = not diagnosed. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. Grey cells indicate the primary diagnosis for each child.

Anxiety symptoms. Raw scores, reliable change scores, ANOVA statistics, and training information for the anxiety symptom outcome measures are shown in Table 11 (Note: Reliable change scores were not calculated for the SPAI as there are no reported test-retest reliability estimates). CS showed a significant reduction in social anxiety symptoms only. He showed raw score reductions for all anxiety symptoms excluding physical injury fears where scores remained unchanged. AC showed significant raw score reductions in generalised anxiety and social anxiety, physical injury fears, panic/agoraphobia, and total anxiety. He showed raw score reductions in separation anxiety and social anxiety (SPAI). He

showed no change in obsessive-compulsive symptoms. BK showed a significant reduction in generalised anxiety, and raw score reductions for separation anxiety, panic/agoraphobia, total anxiety, social anxiety (SCAS and SPAI), and physical injury fears. He showed no change in obsessive-compulsive symptoms. RC showed significant reductions in separation anxiety, and raw score reductions in generalised anxiety, social anxiety (SCAS), physical injury fears, panic/agoraphobia, and total anxiety symptoms. RC also showed a significant increase in obsessive-compulsive symptoms and a raw score increase in social anxiety (SPAI).

In sum, all children received anxiety treatment for social anxiety and generalised anxiety. Three children received anxiety treatment for separation anxiety, and no children received treatment for physical injury fears, panic/agoraphobia, or obsessive-compulsive symptoms. Two children showed significant reductions in generalised anxiety symptoms (AC and BK parent report) or social anxiety symptoms (CS and AC), and single children showed significant reductions in separation anxiety symptoms (RC), physical injury fears (AC), panic/agoraphobia symptoms (AC), and total anxiety symptoms (AC). Three children also showed raw score reductions in social anxiety symptoms on the SPAI (CS, AC, BK).

Table 10

Raw scores and RCI results for parent-reported anxiety symptom outcomes, with an indication of whether each outcome was trained during treatment

		CS	AC	BK	RC
Social anxiety (SPAI; raw scores /52)	T1	25.00	29.70	29.06	24.60
	T2	22.60	20.70	22.18	27.01
	Difference	-2.40	-9.00	-6.88	2.41
	RCI	-	-	-	-
	Trained	✓	✓	✓	✓
Social anxiety (SCAS; raw scores)	T1	15	13	10	9
	T2	11	9	7	7
	Difference	-4	-4	-3	-2
	RCI	3.52	3.52	3.52	3.52
	Trained	✓	✓	✓	✓
Generalised anxiety (SCAS; raw scores)	T1	15	11	15	9
	T2	12	3	11	6
	Difference	-3	-8	-4	-3
	RCI	3.44	3.44	3.44	3.44
	Trained	✓	✓	✓	✓
Separation anxiety (SCAS; raw scores)	T1	11	10	12	8
	T2	10	7	9	4
	Difference	-1	-3	-3	-4
	RCI	3.88	3.88	3.88	3.88
	Trained	✓	✓	✓	X
Physical injury fears (SCAS; raw scores)	T1	6	8	5	9
	T2	6	5	4	8
	Difference	0	-3	-1	-1
	RCI	3.01	3.01	3.01	3.01
	Trained	X	X	X	X
Obsessive-compulsive (SCAS; raw scores)	T1	7	2	0	0
	T2	6	2	0	3
	Difference	-1	0	0	3
	RCI	2.78	2.78	2.78	2.78
	Trained	X	X	X	X
Panic/agoraphobia (SCAS; raw scores)	T1	9	8	6	6
	T2	10	5	5	4
	Difference	1	-3	-1	-2
	RCI	3.04	3.04	3.04	3.04
	Trained	X	X	X	X
Total anxiety (SCAS; raw scores)	T1	63	52	48	41
	T2	55	31	36	32
	Difference	-8	-21	-12	-9
	RCI	14.01	14.01	14.01	14.01
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. High scores indicate high anxiety. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. – indicates that RCI could not be calculated. Grey cells indicate the symptom measure associated with the primary diagnosis for each child.

Anxiety interference. Raw scores, reliable change scores, ANOVA statistics, and treatment information for the anxiety interference outcome measures are shown in Table 12. CS showed non-significant raw score reductions in home, outside home, and parent life interference. AC showed a significant decrease in home interference, a non-significant raw-score increase in outside home interference, and a significant increase in parent life interference. BK showed a significant reduction in parent life interference, a non-significant raw score reduction in home interference, and no change in outside home interference. RC showed significant raw score reductions in outside home interference and parent life interference, and no change in home interference.

In sum, all children received anxiety treatment to lower anxiety interference at home, outside home, and interference on parent life. In line with this, two children showed significant reductions in parent interference (BK, RC) and one child showed a significant reduction in home interference (AC) and outside home interference (RC).

Table 11

Raw scores and RCI results for parent-reported anxiety interference outcomes, with an indication of whether each outcome was trained during treatment

		CS	AC	BK	RC
Home (CALIS/raw scores)	T1	9	10	4	7
	T2	8	6	2	7
	Difference	-1	-4	-2	0
	RCI	2.02	2.02	2.02	2.02
	Trained	✓	✓	✓	✓
Outside (CALIS/raw scores)	T1	10	3	8	12
	T2	8	4	8	7
	Difference	-2	1	0	-5
	RCI	3.23	3.23	3.23	3.23
	Trained	✓	✓	✓	✓
Parent (CALIS/raw scores)	T1	17	6	15	13
	T2	16	14	10	5
	Difference	-1	8	-5	-8
	RCI	4.66	4.66	4.66	4.66
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. High scores indicate poor performance (i.e., high interference). ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

DISCUSSION

The first aim of this study was to pilot the administration of the reading treatments in our version of Cool Reading to determine whether the procedures meet the needs of children with reading and anxiety problems. Due to a lack of empirical evidence, we were unsure whether poor readers with anxiety could cope without feedback about performance during training, and if they may suffer a lack of motivation to practice their reading. Regarding the former, we found that children did indeed seek reassurance (e.g., “did I get that right”) when the clinician (in this case, DF) did not provide immediate feedback on reading accuracy for test items. Hence, we modified instructions to set expectations about whether or not children received feedback. The clinician also noted that children became overwhelmed when provided with too much corrective feedback during text reading. Hence, we decided to only provide corrective feedback during text reading on a specific number of GPC rules or sight words (e.g., two or three) that were trained during the session. Regarding the latter, children’s motivation varied sporadically throughout the treatment. Hence, we increased reward structures (e.g., lucky dip prizes, stickers, games) to maintain motivation. Thus, modifying instructions, selecting specific rules or words for corrective feedback, and providing in-session rewards were helpful reading treatment modifications for children with concomitant poor reading and anxiety.

The second aim of this study was to pilot the administration of Cool Reading anxiety treatment components (core components and optional specific components) to determine if they were appropriate for poor readers with anxiety. We had three key concerns. The first related to whether modifications designed to reduce reliance on reading would make the anxiety treatments of Cool Reading sufficiently accessible to poor readers with anxiety. We found that children completed the activity sheets without difficulty, the cartoon videos were useful clinical tools to teach children the components of Cool Reading, and children

completed the modified Cognitive Restructuring and Gradual Exposure activities by drawing pictures or having their parents write their response. However, children struggled with the written responses that they were supposed to re-read at a later time. Hence, we encouraged children to create a visual cue (e.g., picture or key word) to prompt them to remember their calm thought (e.g., I'll be okay). Children also struggled to draw their steps in the space provided on the Gradual Exposure activity sheet. Hence, the Gradual Exposure activity sheets were enlarged to accommodate children's drawings. These findings suggest that the simplified materials and use of cartoon videos overcame the barrier of poor readers reading difficulties that stopped them from engaging in anxiety treatment.

Our second concern was whether modifications to session structure would reduce efficacy of core and specific anxiety treatment components. We found that it was feasible to progress through anxiety treatment with the multiple sessions per week. It was particularly useful to check in with children and parents multiple times per week to reinforce content.

Our third concern was whether poor readers with anxiety would be able to switch between reading treatment and anxiety treatment within a single treatment session. We found that children were able to switch between administering reading and anxiety treatments within each session. Hence, it is possible to administer both reading and anxiety treatment within a single session.

In addition to these findings, we discovered that Child Management Strategies for Parents, which involved a discussion between the parent and clinician, often exceeded the allocated time because parents had not read the parent manual. This may have been due to parents own reading difficulties (due to the genetic component of poor reading) or lack of time to prepare for sessions. This suggested that future versions of Cool Reading should simplify materials in the parent manual, remind parents to read the relevant sections of the parent manual before each session, and encourage them to ask questions if any instructions

are not clear. We also discovered that children had some difficulty completing homework tasks, particularly if the sessions were scheduled on consecutive days (e.g., Monday and Tuesday). Hence, future versions of Cool Reading may find it useful to schedule sessions on non-consecutive days to allow sufficient time for children to practice.

The third aim of this pilot study was to explore if Cool Reading had an effect on reading outcomes in children with poor reading and anxiety. In this study, all children showed significant improvements for one or more general reading outcomes. Specifically, three children showed significant improvements for reading comprehension, two children showed significant improvements for regular reading accuracy, and individual children showed significant improvements for word reading fluency, and text reading fluency.

The reading comprehension gains are interesting as Cool Reading did not specifically focus on reading comprehension training. Instead, the children's reading treatments focused on improving word accuracy. Word reading accuracy is a foundation skill for reading fluency, and both reading accuracy and reading fluency are foundation skills for reading comprehension (Golinkoff, 1975; Hoover & Gough, 1990; LaBerge & Samuels, 1974; Perfetti & Hogboam, 1970). Hence, it is possible the improvements in word accuracy were responsible for improvements in reading comprehension. Another possibility is that lower anxiety enabled children to focus less on anxiety and focus more on understanding the meaning of text (Bogels & Mansell, 2004).

In line with the DRC model (Coltheart et al., 2001), we assessed the nonlexical and lexical reading routes, as well as individual cognitive components that comprise these routes. All children showed improvements in their nonlexical routes, as demonstrated by significant improvements in nonword reading accuracy (CS, AC), nonword fluency (AC, RC) and nonword spelling (BK). Two children also showed improvements in their lexical route, as shown by significant improvements in irregular word spelling (BK, RC). In terms of the

individual components of these routes, two children with improvements in their nonlexical route showed significant improvements for GPC knowledge of individual graphemes (i.e., individual components of the nonlexical route; AC, RC). These results suggest that the reading treatments used in our version of Cool Reading may have an effect on both the nonlexical and lexical routes, and unique individual components of the nonlexical route (e.g., GPC knowledge), but perhaps not components common to both the nonlexical and lexical routes (i.e., letter processing or phonological output). The reliability of these findings was tested in the following chapter (Chapter 6) that presents an interventional case series study of a refined version of Cool Reading that includes control data.

The fourth aim of this pilot study was to explore if our version of Cool Reading had an effect on anxiety outcomes. The results for remission of anxiety disorders were not as expected. In terms of anxiety disorders, the primary anxiety disorder was not remitted for any children after treatment (i.e., 0% of children). Across the anxiety disorders, 33% of the disorders were no longer present after treatment. Individually, the results showed that two children no longer met criteria for social anxiety disorder, separation anxiety disorder, and any specific phobia. In terms of anxiety symptoms, two children showed significant reductions for generalised anxiety symptoms and social anxiety symptoms, and single children showed significant reductions for separation anxiety symptoms, physical injury fears, panic/agoraphobia symptoms, and total anxiety symptoms. In terms of anxiety interference, three children reported significant reductions for outside home interference, two children reported significant reductions for parent life interference, and one child reported a significant reduction for home interference. Considered together, the remission rates for primary diagnoses were lower than those treatment outcomes reported for the Cool Kids for anxiety program primary diagnoses remission rates (e.g., 68%; Hudson, Rapee, Deveney,

Schniering, Lyneham, & Bovopoulos, 2009). Below, we discuss four possible reasons for the lower treatment response rates reported in this study.

First, it is possible that severe anxiety disorders and symptoms contributed to the low treatment response rate (Layne, Bernstein, Egan, & Kushner, 2003; Manassis et al., 2004). AC met criteria for five anxiety disorders, three of which were assigned a severity rating that was “markedly severe” before treatment. While AC could be considered more severe due to the fact that he had the greatest number of markedly severe diagnoses, he showed significant improvements for separation anxiety disorder, specific phobia, and for parent reported total anxiety symptoms. The severity ratings are also consistent with the mean severity ratings in comparable trials (Hudson et al., 2013). Hence, initial symptom severity does not appear to explain the lower response rates reported in this study.

Second, the presence of other conditions or disorders can lower response to anxiety treatment (Kennard et al., 2005). While comorbidity of other cognitive and emotional disorders was an exclusionary criterion in this study, all children had one or more problems for reading self-concept, peer relations, attention, or behaviour. Specifically, four children reported hyperactivity and hyperactivity/inattention problems (CS, AC, BK, RC), three children reported poor reading self-concept (CS, BK, RC), three children reported inattention problems (CS, AC, RC), two children reported behaviour problems (CS, AC), and one child reported peer problems (CS). In sum, CS reported five clinically elevated comorbidities (poor reading self-concept, peer problems, inattention, hyperactivity, combined inattention and hyperactivity, and defiance and aggression) while BK reported three comorbidities (poor reading self-concept, hyperactivity, hyperactivity and inattention). After treatment, CS did not meet diagnostic criteria for social anxiety disorder and specific phobia. He also showed significant reductions in anxiety symptoms. BK continued to meet diagnostic criteria for all anxiety disorders, and only showed a reduction for parent reported generalised anxiety

symptoms. Hence, the presence of other conditions does not seem to account for the lower anxiety treatment outcomes reported in the present study.

Third, poor spoken language may offer an explanation for our findings. Poor language skills could reduce children's ability to engage in anxiety treatment. AC had the poorest spoken language skills yet did not meet criteria for two anxiety disorders, and showed a significant reduction for total anxiety symptoms after treatment. In contrast, BK performed within the average range for spoken language skills and yet as mentioned above, continued to meet diagnostic criteria for all anxiety disorders after treatment. Thus, poor spoken language does not account for the poor anxiety improvements in the present study.

Fourth, differences in the intensity of the treatment may explain the anxiety outcomes. In the MURC, reading intervention is typically administered as three 45-minute sessions per week for 12 weeks. The Cool Kids Anxiety program is typically administered as one 1-hour session per week for 10 weeks. In Cool Reading, the overall dosage of treatment remains the same for reading treatment (approximately 22.5-hours of treatment) and anxiety treatment (10-hours of treatment). The intensity of individual sessions remained very similar for the reading treatment, but changed substantially for anxiety treatment. For instance, one 1-hour session was split amongst three 15 to 20-minute sessions per week after reading treatment. Thus, it is possible that this change of intensity accounted for the lower than expected anxiety outcomes in this study.

Another possible explanation for our lower than expected anxiety outcomes may be that social anxiety specifically contributed to the low anxiety treatment outcomes in the current study. Research suggests that children with social anxiety disorder have significantly lower response rates to treatment compared to children with other anxiety disorders (Hudson et al., 2013; Hudson, Rapee, Lyneham, McLellan, Wuthrich, & Schniering, 2015). In the current study, all children were diagnosed with social anxiety disorder, two of whom received

a primary diagnosis of social anxiety disorder. Given that all children were diagnosed with social anxiety disorder in the current study, and 50-55% of poor readers with anxiety had social anxiety symptoms on our profiling study (Chapter 3), we decided to add components from the Cool Kids Social programme (Centre for Emotional Health, 2016) into Cool Reading. These components included attention training exercises, safety behaviours experiments, and video feedback experiments. In terms of attention, children practiced reducing their self-focused attention (e.g., I worry that people will laugh at me) to instead focus on reading (e.g., focus their attention to the words on the page). In terms of safety behaviour experiments, children practiced reading aloud with and without safety behaviours (e.g., reading aloud whilst avoiding and making eye contact). In terms of video feedback experiments, children watched videos of themselves reading aloud to develop an accurate perception of their ability.

Another modification that we planned for the next version of Cool Reading was the introduction of Gradual Exposures in the third week rather than the sixth week. As outlined in Chapter 4, we introduced Cool Reading Gradual Exposures mid-way through Cool Reading to give children time to improve both their reading and coping skills in order to mitigate negative reading-related exposures (e.g., the child reads aloud and makes a mistake and then children laugh). This reduced the number of in-session exposures compared to the original Cool Kids programme, and hence limited the opportunity for children to practice gradual exposures. Indeed, none of the children completed gradual exposures related to reading. Hence, introducing Gradual Exposures in Week 3 would increase the quantity, intensity, and specificity of the gradual exposures related to reading. These changes also necessitated refinements to the children's workbook and the clinician manual.

Limitations and future directions

These outcomes must be considered within the context of the strengths and weaknesses of this study. First, as discussed above, we did not collect control data as this pilot study was designed primarily to test and refine the Cool Reading treatment components to maximise accessibility for anxious poor readers. The lack of control group means that we cannot rule out the possibility that non-treatment effects were responsible for the observed reading and anxiety gains. These non-treatment effects include test-retest effects (e.g., improvements are a result of repeated testing – although test-retest estimates were included in the RCI calculation), regression towards the mean (e.g., scoring closer to the mean score on repeated testing), maturation (e.g., reading improves and anxiety decreases over time), and history (e.g., improvements may be due to school or spontaneous remission). Thus, it is critical that future studies of Cool Reading include control data. This issue is addressed in a controlled interventional case series study that is outlined in Chapter 6.

The second limitation is the very small sample of children that were included in this case series ($N = 4$). This small sample was appropriate for the first detailed pilot study of Cool Reading. The results from this study can be used to develop hypotheses about the possible effects of Cool Reading on reading and anxiety outcomes in future interventional case series that include control data (see Chapter 6), and subsequent group studies that may test the efficacy of Cool Reading in larger groups of children with concomitant poor reading and anxiety.

The final limitation pertains to our analysis. We used an RCI analysis to determine clinically meaningful change, which is suitable for pre- versus post-intervention designs to evaluate change in scores. However, this approach is dependent on the psychometric properties and reliability estimates of the measures (Duff, 2012) which were not available for some of the outcome measures in this pilot study. Future interventional case series and randomised controlled trials can avoid this problem by including control data to determine if

poor readers with anxiety make greater gains in reading or anxiety outcomes after Cool Reading training compared to a non-training period (see Chapter 6) or a non-treatment control group.

Summary

To summarise, this study aimed to pilot the administration and outcomes of Cool Reading with four individual children with concomitant reading and anxiety problems. Specifically, we piloted Cool Reading to determine if and how the reading (Aim 1) and anxiety treatment components should be modified (Aim 2), and explore if Cool Reading improves reading (Aim 3) and anxiety outcomes for poor readers with anxiety (Aim 4). During this study, we found that Cool Reading had an effect on general reading skills (reading comprehension, reading accuracy), the nonlexical route and individual components of the nonlexical route (nonword reading accuracy, nonword reading fluency, nonword spelling, GPC knowledge), and the lexical route (irregular spelling). We also found that Cool Reading had lower than expected effects on anxiety outcomes. Hence, we made two significant modifications to the anxiety treatment components (i.e., specific social anxiety treatment components, increasing the frequency of Gradual Exposures). In Chapter 6, we evaluate the effectiveness of our final version of Cool Reading in an interventional case series that included seven children with concomitant poor reading and anxiety.

REFERENCES

- Adams, C., Coke, R., Crutchley, A., Hesketh, A., & Reeves, D. (2001). *Assessment of comprehension and expression 6–11*. London: NFER-Nelson.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.
- Beidel, D. C., Turner, S. M., Hamlin, K., & Morris, T. L. (2000). The Social Phobia Anxiety Inventory for Children (SPAI-C): External and discriminative validity. *Behavior Therapy, 31*, 75–87. doi: 10.1016/S0005-7894(00)80005-2
- Bell-Dolan, D. J., Last, C. G., & Strauss, C. C. (1990). Symptoms of anxiety disorders in normal children. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 759-765. doi: 10.1097/00004583-199009000-00014
- Bogels, S. M., & Mansell, W. (2004). Attention processes in the maintenance and treatment of social phobia: Hypervigilance, avoidance, and self-focused attention. *Clinical Psychology Review, 28*, 827-856. doi: 10.1016/j.cpr.2004.06.005
- Brunsdon, R., Coltheart, M., & Nickels, L. (2005). Treatment of irregular word spelling in developmental surface dysgraphia. *Cognitive Neuropsychology, 22*, 213-251. doi: 10.1080/02643290442000077
- Castles, A., & Coltheart, M. (1996). Cognitive correlates of developmental surface dyslexia: A single case study. *Cognitive Neuropsychology, 13*, 25–50. doi: 10.1080/026432996382051
- Castles, A., Coltheart, M., Larsen, L., Jones, P., Saunders, S., & McArthur, G. (2009). Assessing the basic components of reading: A revision of the Castles and Coltheart test with new norms. *Australian Journal of Learning Difficulties, 14*, 67-88. doi: 10.1080/19404150902783435
- Centre for Emotional Health (2016). *The Cool Kids Social Treatment Program*. Sydney,

Australia: Macquarie University

- Chapman, J. W., & Tunmer, W. E. (1995). Development of young children's reading self-concepts: An examination of emerging subcomponents and their relationship with reading achievement. *Journal of Educational Psychology*, 87, 154-167. doi: 10.1037/0022-0663.87.1.154
- Colenbrander, D., Kohnen, S., & Nickels, L. (2011). *Diagnostic reading test for nonwords (DiRT)*. Retrieved from <http://www.motif.org.au>
- Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, 108, 204–256. doi: 10.1037/0033-295X.108.1.204
- Conners, K. C. (2008). *Conners 3 (3rd ed.)*. New York: Multi-Health Systems Inc.
- Costello, E.J., Mustillo, S., Erkanli, A., Keeler, G., & Angold, A. (2003). Prevalence and development of psychiatric disorders in childhood and adolescence. *Archives of General Psychiatry*, 60, 837-844. doi: 10.1001/archpsyc.60.8.837
- Dodd, B., Holm, A., Oerlemans, M., & McCormick, M. (1996). *Queensland Inventory of Literacy (QUIL)*. Brisbane, Australia: University of Queensland.
- Duff, K. (2012). Evidence-based indicators of neuropsychological change in the individual patient: Relevant concepts and methods. *Archives of Clinical Neuropsychology*, 27, 248-261. doi: 10.1093/arclin/acr120
- Gallant, S., Conners, K., Rzepa, S., Pikanen, J., Marocco, M., & Sitarenios, G. (2007). Psychometric Properties of the Conners 3rd Edition.
- Golinkoff, R. M. (1975). A comparison of reading comprehension processes in good and poor comprehenders. *Reading Research Quarterly*, 4, 624-659. doi: 10.2307/747459

- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38, 581-586. doi: 10.1111/j.1469-7610.1997.tb01545.x
- Goulandris, N. K., & Snowling, M. J. (1991). Visual memory deficits: A plausible cause of developmental dyslexia? Evidence from a single case study. *Cognitive Neuropsychology*, 8, 127–154. doi: 10.1080/02643299108253369
- Grills, A. E., Fletcher, J. M., Vaughn, S., Barth, A., Denton, C. A., & Stuebing, K. K. (2014). Anxiety and response to reading intervention among first grade students. *Child Youth Care Forum*, 43, 417-431. doi: 10.1007/s10566-014-9244-3
- Hudson, J. L., Lester, K. J., Lewis, C. M., Tropeano, M., Creswell, C., Collier, D. A., ... & Roberts, S. (2013). Predicting outcomes following cognitive behaviour therapy in child anxiety disorders: the influence of genetic, demographic and clinical information. *Journal of Child Psychology and Psychiatry*, 54, 1086-1094.
- Hudson, J. L., Newall, C., Rapee, R. M., Lyneham, H. J., Schniering, C. C., Wuthrich, V. M. et al. (2014). The Impact of Brief Parental Anxiety Management on Child Anxiety Treatment Outcomes: A Controlled Trial. *Journal of Clinical Child & Adolescent Psychology*, 43, 370-380. doi: 10.1080/15374416.2013.807734
- Hudson, J. L., Rapee, R. M., Lyneham, H. J., McLellan, L. F., Wuthrich, V. M., & Schniering, C. A. (2015). Comparing outcomes for children with different anxiety disorders following cognitive behavioural therapy. *Behaviour research and therapy*, 72, 30-37.
- Hudson, J.L., Rapee, R.M., Deveney, C., Schniering, C.A., Lyneham, H., & Bovopoulos, N. (2009). Cognitive behavioural treatment versus an active control for children and adolescents with anxiety disorders: A randomised trial. *Journal of the American*

- Academy of Child and Adolescent Psychiatry*, 48, 533-544. doi:
10.1097/CHI.0b013e31819c2401
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal*, 2, 127–160. doi: 10.1007/BF00401799
- Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, 59, 12-19. doi: 10.1037/0022-006X.59.1.12
- James, A.C., James, G., Cowdrey, F.A., Soler, A., & Choke, A. (2013). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *Cochrane Database of Systematic Reviews*, 6, CD004690. doi:
10.1002/14651858.CD004690.pub3.
- Kaufman, A., & Kaufman, N. (2004). *Manual for the Kaufman Brief Intelligence Test*. Circle Pines, MN: American Guidance Service.
- Kennard, B. D., Ginsburg, G. S., Feeny, N. C., Sweeney, M., & Zagurski, R. (2005). Implementation challenges to TADS cognitive-behavioral therapy. *Cognitive and Behavioral Practice*, 12, 230–239.
- Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry*, 62, 593-602. doi: 10.1001/archpsyc.62.6.593
- Kohnen, S., Anandakumar, T., McArthur, G. & Castles, A. (2012). *The Test of Orthographic Choice (TOC)*. Available from www.motif.org.au
- Kohnen, S. & Banales, E. (2015a). *The Macquarie University Reading Clinic Reading Gap intervention program*. Sydney: Macquarie University.

- Kohnen, S. & Banales, E. (2015b). *The Macquarie University Reading Clinic Spelling Gap intervention program*. Sydney: Macquarie University.
- Kohnen, S. & Banales, E. (2015c). *The Macquarie University Reading Clinic Sight words intervention program*. Sydney: Macquarie University.
- Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.
- Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.
- Kohnen, S., Larsen, L., Jones, K., Castles, A., & McArthur, G. (2012). *The Meanings of Written Words Test (MeOWW)*. Available from www.motif.org.au.
- Kohnen, S., Nickels, L., & Castles, A. (2009). *Diagnostic spelling test – Spelling nonwords to dictation*. Retrieved from <http://www.motif.org.au>
- Krueger, R. F., & Eaton, N. R. (2015). Transdiagnostic factors of mental disorders. *World Psychiatry, 14*, 27-29. doi: 10.1002/wps.20175
- Laberge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293-323. doi: 10.1016/0010-0285(74)90015-2
- Langley, A. K., Bergman, R. L., McCracken, J., & Piacentini, J. C. (2004). Impairment in childhood anxiety disorders: Preliminary examination of the child anxiety impact scale - parent version. *Journal of Child and Adolescent Psychopharmacology, 14*, 105–114. doi: 10.1089/104454604773840544
- Larsen, L., Kohnen, S., Nickels, L., & McArthur, G. (2015). The letter-sound test (LeST): A reliable and valid comprehensive measure of grapheme-phoneme knowledge. *Australian Journal of Learning Difficulties, 20*, 129-142. doi: 10.1080/19404158.2015.1037323

- Lawrence, D., Johnson, S., Hafekost, J., de Haan, K. B., Sawyer, M., Ainley, J., & Zubrick, S. R. (2015). *The mental health of children and adolescents: Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Canberra, Australia: Department of Health.
- Layne, A. E., Bernstein, G. A., Egan, E. A., & Kushner, M. G. (2003). Predictors of treatment response in anxious-depressed adolescents with school refusal. *Journal of the American Academy of Child and Adolescent Psychiatry*, 42, 319–326. doi: 10.1097/00004583-200303000-00012
- Lyneham, H.J., Abbott, M.J., & Rapee, R.M. (2006). Evaluation of therapist-supported parent- implemented CBT for anxiety disorders in rural children. *Behaviour Research & Therapy*, 44, 1287-1300. doi: 10.1016/j.brat.2005.09.009
- Lyneham, H. J., Abbott, M. J., Wignall, A., & Rapee, R.M. (2003). *The Cool Kids Anxiety Treatment Program*. Sydney, Australia: MUARU, Macquarie University
- Lyneham, H. J., & Rapee, R. M. (2005). Agreement between telephone and in-person delivery of a structured interview for anxiety disorders in children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 44, 274-282. doi: 10.1097/00004583-200503000-00012
- Lyneham, H. J., Sburlati, E. S., Abbott, M. J., Rapee, R. M., Hudson, J. L., Tolin, D. F., & Carlson, S. E. (2013). Psychometric properties of the child life interference scale (CALIS). *Journal of Anxiety Disorders*, 27, 711-719. doi: 10.1016/j.janxdis.2013.09.008
- Manassis, K., Avery, D., Butalia, S., & Mendlowitz, S. L. (2004). Cognitive-behavioral therapy with childhood anxiety disorders: functioning in adolescence. *Depression and Anxiety*, 19, 209– 216. doi: 10.1002/da.10133

- McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015a). Sight word and phonics training in children with dyslexia. *Journal of Learning Disabilities, 48*, 391-407. doi: 10.1177/0022219413504996
- McArthur, G., Kohnen, S., Jones, K., Eve, P., Banales, E., Larsen, L., & Castles, A. (2015b). Replicability of sight word training and phonics training in poor readers: A randomised controlled trial. *PeerJ 3*:e922. doi: 10.7717/peerj.922
- Muris, P., & Meesters, C. (2002). Symptoms of anxiety disorders and teacher-reported school functioning of normal children. *Psychological Reports, 91*, 588-590. doi: 10.2466/pr0.2002.91.2.588
- Muter, V., Hulme, C., Snowling, M.J. & Stevenson, J. (2004). Phonemes, rimes, vocabulary and grammatical skills as foundations of early reading development: Evidence from a longitudinal study. *Developmental Psychology, 40*, 665-681. doi: 10.1037/0012-1649.40.5.665
- Neale, M. (1999). *Neale analysis of reading ability (3rd ed.)*. Melbourne: Australian Council for Educational Research.
- Perfetti, C. A., & Hogaboam, T. (1975). Relationship between single word decoding and reading comprehension skill. *Journal of Educational Psychology, 67*, 461-469.
- Peris et al., Caporino, N. E., O'Rourke, S., Kendall, P. C., Walkup, J. R., & Albano, A. M. et al. (2017). Therapist-reported features of exposure tasks that predict differential treatment outcomes for youth with anxiety. *Journal of the American Academy of Child and Adolescent Psychiatry, 56*, 1043-1052. doi: 10.1016/j.jaac.2017.10.001.
- Pine, D.S., Cohen, P., Gurley, D., Brook, J., Ma, Y. (1995). The risk for early-adulthood anxiety and depressive disorders in adolescents with anxiety and depressive disorders. *Archives of General Psychiatry, 55*, 56-64. doi: 10.1001/archpsyc.55.1.56
- Pitchford, N., & Eames, K. (1994). Squirrel-nut test. Unpublished manuscript, produced

while the authors were at Royal Holloway, University of London, and Coventry University.

- Plaut, D. C., McClelland, J. L., Seidenberg, M. S., & Patterson, K. (1996). Understanding normal and impaired word reading: Computational principles in quasi-regular domains. *Psychological Review*, 103, 56-115. doi: 10.1037/0033-295X.103.1.56
- Rapee, R. M., Schniering, C. A., & Hudson, J. L. (2009). Anxiety disorders during childhood and adolescence: origins and treatment. *Annual Review of Clinical Psychology*, 5, 311–341. doi: 10.1146/annurev.clinpsy.032408.153628
- Rozenman, M., Weersing, V. R., & Amir, N. (2011). A case series of attention modification in clinically anxious youths. *Behaviour Research and Therapy*, 49, 324-330. doi: 10.1016/j.brat.2011.02.007
- Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. *Clinical Psychology Review*, 20, 453-478. doi: 10.1016/S0272-7358(99)00037-9
- Semel, E., Wiig, E., & Secord, W. (2006). *Clinical evaluation of language fundamentals (4th ed., Australian standardised edition (CELF-4 Australian))*. Sydney, Australia: Pearson Inc.
- Seidenberg, M. S., & McClelland, J. L. (1989). A distributed, developmental model of word recognition and naming. *Psychological Review*, 96, 523-568. doi: 10.1037/003-295X.96.4.523
- Silverman, W. K., & Albano, A. M. (1996). *The Anxiety Disorders Interview Schedule for Children for DSM-IV: Child and Parent Versions*. San Antonio, TX: Psychological Corporation.
- Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour Research and Therapy*, 36, 545-566. doi: 10.1016/S0005-7967(98)00034-5

- Spence, S. H., Donovan, C. L., March, S., Gamble, A., Anderson, R., Prosser, S., Kercher, A., & Kenardy, J. (2008). Online CBT in the treatment of child and adolescent anxiety disorders: Issues in the development of BRAVE-ONLINE and two case illustrations. *Behavioural and Cognitive Psychotherapy*, 36, 411-430. doi: 10.1017/S135246580800444X
- Strauss, C. C., Frame, C. L., & Forehand, R. (1987). Psychosocial impairment associated with anxiety in children. *Journal of Clinical Child Psychology*, 16, 235-239. doi: /10.1207/s15374424jccp1603_8
- Temple, C. M., & Marshall, J. C. (1983). A case study of developmental phonological dyslexia. *British Journal of Psychology*, 74, 517-533. doi: 10.1111/j.2044-8295.1983.tb01883.x
- Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of word reading efficiency (TOWRE)*. Austin, TX: ProEd.
- Wang, H., Nickels, L., & Castles, A. (2015). Orthographic learning in developmental surface and phonological dyslexia. *Cognitive Neuropsychology*, 32, 58-79. doi: 10.1080/02643294.2014.1003536
- Wheldall, K., & Madelaine, A. (2013). *The Wheldall assessment of reading passages (WARP) manual*. Sydney: MultiLit Pty.
- Wheldall, K., & McMurtry, S. (2014). Preliminary evidence for the validity of the new Test of Everyday Reading Comprehension. *Australian Journal of Learning Difficulties*, 19, 173-178. doi: 10.1080/19404158.2014.979525

APPENDIX A

Information and consent forms sent to parents

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4134



Parent Information and Consent Form

Project Title: The Relationship between Emotional Health and Children's Reading Ability

Thank you for your interest in our research. This study is being conducted to meet the requirements of a PhD research program in Cognitive Science at Macquarie University. This research is being conducted by Deanna Francis and supervised by Professor Genevieve McArthur (Department of Cognitive Science, t: 9850 9162, e: genevieve.mcarthur@mq.edu.au) and Professor Jennifer Hudson (Department of Psychology, t: 9850 8668, e: jennie.hudson@mq.edu.au).

What is the study about?

Our research is trying to understand the relationship between reading difficulties and poor emotional health so we can discover new ways to treat these two problems in children. In this study, we are developing and testing a new intervention for children aged 8 to 12 years who have both poor reading and anxiety.

What will we be asked to do?

Your child will be given a 12-week, individualized, face-to-face program that combines reading and anxiety interventions. Each week, your child will complete three 60-minute training sessions. The first two sessions in the program will focus just on anxiety. The remaining 34 sessions will combine reading training and anxiety training. The sessions can be conducted at the Macquarie University Reading Clinic (face-to-face sessions) and/or via Skype - depending on the family's circumstances. Your child will work with the same clinician in each session.

To assess how well the combined reading and anxiety treatment works, we will assess your child's reading and anxiety before the intervention starts. We will also ask parents to complete questionnaires on your child's emotional health. Then, after the 12 weeks of training, we will redo all the same tests again to see how much progress your child has made over the 12 weeks of training. All tests will be conducted by the clinician who also does the intervention.

Are there any benefits associated with the study?

If you choose to participate in the study, your child will receive individualised reading training and anxiety training free of charge. The reading training is the same treatment used in the Macquarie University Reading Clinic, and the anxiety program is an adapted version of a popular program used in the Macquarie University Emotional Health Clinic. Given the success of these separate programs in the past, we predict your child will improve their reading and anxiety. However, we cannot guarantee that this will occur since no-one has combined these two programs before. This is why we need to do this study.

Your child will receive a token for each training session that they complete. With your approval, at the end of all the training, we will give your child \$3 for every training session that they successfully complete. If they complete all sessions, they will receive a total of \$100. You may choose to give that money to your child or put the money in their bank account. If you do not approve of your child receiving money for doing the training, you may refuse the money.

In addition to the training, we will provide you with written and verbal results of both assessments.

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Are there any risks associated with the study?

We are yet to work with a child who finds our procedures upsetting. However, it is possible a child could find it difficult to talk about their feelings. If this was to occur, we would stop the interview and contact parents immediately to discuss the issue. If desired, we would facilitate an appointment at the Centre for Emotional Health. The Centre for Emotional Health provide face-to-face and online appointments with clinical psychologists. Information about the services offered at the Centre of Emotional Health can be found here: <http://www.centreforemotionalehealth.com.au>).

Will our information be confidential?

We will need to audio-record your child's responses on some of the tests so that we can double check our scoring. These audio-recordings will be deleted once the scoring has been finished.

All information collected from you and your child will be kept confidential and will not be disclosed to third parties without written consent, except as required by law. The results of each child are de-identified, and no identifying information about individual children will be included in any publications or presentations. Only the researchers identified as working on this project will have access to the data, and a summary of the results from this study can be made available to you on request by contacting the above-mentioned researchers.

Please also note that participation in the study is voluntary, and you and your child are free to withdraw from this study at any time.

How do I return the questionnaire and consent forms?

If you and your child would like to participate in this research, please complete the consent form and return it to us via email (anxietyreadingstudy@mq.edu.au) or post (see below):

Deanna Francis
Department of Cognitive Science
Australian Hearing Hub
16 University Ave
Macquarie University, NSW 2109

If you have any questions, please do not hesitate to contact Deanna at anxietyreadingstudy@mq.edu.au.

Yours faithfully,

Deanna Francis
PhD Candidate
Department of Cognitive Science
Macquarie University NSW 2109
Australia

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4134



Consent Form

Participation in this study is entirely voluntary. You are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence.

We _____ (parent/guardian) have read and understand the information above, and have asked questions that have been answered to our satisfaction. We have discussed the procedures with our child, _____ (child), and agree to participate in this research. We understand that we have the freedom to withdraw our consent to participate and can discontinue our involvement at any time without prejudice to any future relationship with the investigators.

I would like to be contacted about future research studies at Macquarie University YES / NO

Date: _____

Name: (mother) _____ Signed: _____

Name: (father) _____ Signed: _____

Name: (child) _____ Signed: _____

Name: (investigator) _____ Signed: _____

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Participant's Copy (please keep)

Department of Cognitive Science
Faculty of Human Sciences
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4134



Consent Form

Participation in this study is entirely voluntary. You are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence.

We _____ (parent/guardian) have read and understand the information above, and have asked questions that have been answered to my satisfaction. We have discussed the procedures with our child, _____ (child), and agree to participate in this research. We understand that we have the freedom to withdraw our consent to participate and can discontinue our involvement at any time without prejudice to any future relationship with the investigators.

I would like to be contacted about future research studies at Macquarie University YES / NO

Date: _____

Name: (mother) _____ Signed: _____

Name: (father) _____ Signed: _____

Name: (child) _____ Signed: _____

Name: (investigator) _____ Signed: _____

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Investigator's Copy (please return to the investigator)

APPENDIX B

Background questionnaire completed by parents

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cogsci@mq.edu.au



MACQUARIE
University

The Relationship between Emotional Health and Poor Reading

Parent/Guardian Contact Details

Parent/Guardian:.....

Address:.....

Phone/Mobile:.....

Email:.....

Child Details

Name:

Date of Birth:

Sex (*please circle*):

- Male
- Female

Ethnicity (*please circle*):

- Australian
- Aboriginal or Torres Strait Islander
- Other (*please specify*)

○

Does your child speak English only? YES / NO

If YES Progress to "Developmental and Medical History"

If NO, what other languages does your child speak?.....

Does s/he speak these languages fluently?YES / NO

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

How long has your child spoken English?

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

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Developmental & Medical History

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

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

Did your child reach physical developmental (e.g., crawl, walk) milestones in time?..... YES / NO

Does your child have normal hearing? YES / NO

Does your child have normal vision (or corrected with glasses/contacts) YES / NO

Does your child have a history of:

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

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

.....

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 delayYES / NO
- Learning Disability.....YES / NO

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

.....

Education

School:.....

Grade of School (grade / term)

Did your child attend kindergarten/prep and every year after that? YES / NO

Has your child ever skipped a year of school? YES / NO

If YES, what year(s) did they skip?

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Has your child ever repeated year of school? YES / NO

If YES, what year(s) did they repeat?

Has your child ever attended a learning specialist school?YES / NO

If YES, please specify (i.e., duration):

.....
.....

Reading and Spelling

Does your child have trouble reading? YES / NO

If YES, what difficulties do they have?

Has your child been diagnosed with dyslexia? YES / NO

If YES, please provide details (i.e., age of diagnoses, any treatment/intervention)

.....
.....

Does your child have trouble understanding what they read?..... YES / NO

If YES, what difficulties do they have?

Does your child receive any support or intervention for this difficulty? (please specify)

.....
.....

Does your child have trouble spelling? YES / NO

If YES, what difficulties do they have?

Has your child been diagnosed with dysgraphia? YES / NO

If YES, please provide details (i.e., age of diagnoses, any treatment/intervention)

.....
.....

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Emotional Health

Has your child ever experienced anxiety in the **past**? YES / NO

If YES, what symptoms of anxiety have they experienced?

.....

Does your child **currently** experience anxiety? YES / NO

If YES, what symptoms of anxiety do they currently experience?

.....

Has your child been diagnosed with anxiety? YES / NO

If YES, please provide details (i.e., age of diagnoses, treatment/intervention)

.....

.....

Is your child currently taking any medication for anxiety?.....YES / NO

If YES, please specify the type and length of medication:

.....

Has your child ever experienced depression in the **past**? YES / NO

If YES, what symptoms of depression have they experienced?

.....

Does your child **currently** experience depression?YES / NO

If YES, what symptoms of depression do they currently experience?

.....

Has your child been diagnosed with depression?YES / NO

If YES, please provide details (i.e., age of diagnoses, treatment/intervention)

.....

.....

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Is your child currently taking any medication for depression?..... YES / NO

If YES, please specify the type and length of medication:

.....

Does your child experience any other emotional health concerns? YES / NO

If YES, please provide details

.....

.....

Has your child ever experienced bullying..... YES / NO

If YES, please provide details

.....

.....

Family 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:

.....

.....

Is there any additional information you would like to share with us? For example, are there aspects of your culture, religious or other beliefs and values that you would like us to take into consideration when working with your child?

.....

.....

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coseci@mq.edu.au



MACQUARIE
University

Parent/Guardian: Demographic Information

Parent/guardian:.....

Date of Birth:

Sex (please circle): Male Female

Marital status (please circle):

- Married / de facto
- Divorced / separated
- Never married

Family structure (please circle):

- Original
- Stepfamily
- Sole parent
- Other (*please specify*)

Country of birth (please circle):

- Australia
- Other (*please specify*)

Ethnicity (please circle):

- Australian
- Aboriginal or Torres Strait Islander
- Other (*please specify*)

Education (please circle):

- <10 years
- 10-11years
- 12 years
- Trade/TAFE
- University

Employment (please circle):

- Full time
- Part time
- Casual
- Not employed

Household income (please circle):

- \$0-\$25000
- \$25000-\$45000
- \$45000-\$70000
- >\$70000
- DK/DNA

Thank you for taking the time to complete this questionnaire ☺

APPENDIX C

Table C1.

Raw scores and RCI results for child-reported anxiety symptom outcomes, with an indication of whether each outcome was trained during treatment

		CS	AC	BK	RC
Social anxiety (SCAS; raw scores)	T1	8	7	3	2
	T2	4	8	5	5
	Difference	-4	1	2	3
	RCI	5.80	5.80	5.80	5.80
	Trained	✓	✓	✓	✓
Social anxiety (SPAI; raw scores /52)	T1	17.00	24.45	16.65	15.00
	T2	28.00	30.38	23.50	20.46
	Difference	11.00	5.93	6.85	5.46
	RCI	8.04	8.04	8.04	8.04
	Trained	✓	✓	✓	✓
Generalised anxiety (SCAS; raw scores)	T1	6	6	4	6
	T2	6	8	4	7
	Difference	0	2	0	1
	RCI	4.94	4.94	4.94	4.94
	Trained	✓	✓	✓	✓
Separation anxiety (SCAS; raw scores)	T1	6	13	4	6
	T2	3	9	3	6
	Difference	-3	-4	-1	0
	RCI	4.16	4.16	4.16	4.16
	Trained	✓	✓	✓	X
Physical injury fears (SCAS; raw scores)	T1	2	5	4	3
	T2	3	10	4	5
	Difference	1	5	0	2
	RCI	4.17	4.17	4.17	4.17
	Trained	✓	✓	✓	✓
Obsessive-compulsive (SCAS; raw scores)	T1	1	7	8	3
	T2	2	6	6	6
	Difference	1	-1	-2	3
	RCI	5.43	5.43	5.43	5.43
	Trained	X	X	X	X
Panic/agoraphobia (SCAS; raw scores)	T1	4	9	3	1
	T2	0	9	0	5
	Difference	-4	0	-3	4
	RCI	6.57	6.57	6.57	6.57
	Trained	X	X	X	X
Total anxiety (SCAS; raw scores)	T1	27	47	26	21
	T2	18	50	22	34
	Difference	-9	3	-4	13
	RCI	22.91	22.91	22.03	22.03
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. High scores indicate high anxiety. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. Grey cells indicate the symptom measure associated with the primary diagnosis for each child.

Table C2.

Raw scores and RCI results for child-reported anxiety interference outcomes, with an indication of whether each outcome was trained during treatment

		CS	AC	BK	RC
Home (CALIS/raw scores)	T1	4	7	3	3
	T2	4	6	5	1
	Difference	0	-1	2	-2
	RCI	2.23	2.23	2.23	2.23
	Trained	✓	✓	✓	✓
Outside (CALIS/raw scores)	T1	2	10	0	2
	T2	0	6	2	0
	Difference	-2	-4	2	-2
	RCI	2.36	1.36	1.36	1.36
	Trained	✓	✓	✓	✓

Note. Reliable changes are bolded. High scores indicate high interference.

CHAPTER 6

The Cool Reading Programme: An Interventional Case Series Study

Author's statement: DF was responsible for the content of this paper, for the data collection, and the data analysis. GM, and JH provided feedback on the revisions of this paper. JH also

provided supervision. LM (clinical psychologist) collected data for anxiety disorder outcomes at T3.

ABSTRACT

Thus far, we have developed the very first integrated reading and anxiety intervention for poor readers – Cool Reading (Chapter 4). We administered Cool Reading to four children in a pilot interventional case series to determine the suitability of this intervention for poor readers with anxiety (Chapter 5). The outcomes of this pilot study were promising. Hence in the current study, we sought to evaluate if Cool Reading significantly improved (1) general reading skills, the nonlexical and lexical reading routes, and the cognitive components of these reading routes; and (2) anxiety disorders, anxiety symptoms, and anxiety interference. We conducted a 12-week interventional case series study using a within-subjects double baseline control period with seven children. The results revealed that Cool Reading significantly improved general reading skills (reading accuracy), the nonlexical route (nonword reading and spelling), the lexical route (spelling irregular and sight words) and an individual component of the nonlexical route (GPC knowledge). We also found that Cool Reading significantly reduced anxiety disorders (primary anxiety diagnoses for social anxiety, generalised anxiety, separation anxiety, specific phobias), anxiety symptoms (social anxiety, generalised anxiety, separation anxiety), and anxiety interference (home, outside of home, and parent life). Considered together, these results suggest Cool Reading is a promising intervention for concomitant reading and anxiety problems in children.

Keywords: poor reading; anxiety disorders; interventional case series; treatment.

INTRODUCTION

To recount our findings so far, we have confirmed that there is a reliable association between poor reading and anxiety (Chapter 2), and we have found that children with concomitant poor reading and anxiety may be characterised by broad and severe reading problems, poor reading self-concept, social anxiety, and poor attention (Chapter 3). We have developed Cool Reading – the first combined reading and anxiety intervention for children (Chapter 4) – and we have pilot tested and refined this intervention to suit children with concomitant poor reading and anxiety (Chapter 5). In this chapter, we present a larger interventional case series study using a within-subjects double baseline control period that tests the revised version of Cool Reading in children with poor reading and anxiety.

Reading and anxiety outcomes

The first aim of this case series was to evaluate whether Cool Reading significantly improves reading outcomes in children with poor reading and anxiety. The results from our pilot study suggested that Cool Reading may significantly improve general reading skills (word accuracy and reading comprehension), the nonlexical reading route (nonword reading accuracy, fluency, and spelling), and an individual component of the nonlexical reading route (grapheme phoneme correspondence (GPC) knowledge). However, the findings were mixed regarding improvements in the lexical reading route: some children showed significant improvements for irregular word spelling but not irregular word reading. There were no significant improvements for individual cognitive components of the lexical route.

In the current study, we test the efficacy of the revised version of Cool Reading on reading outcomes in an interventional case series that collected control data in a double baseline period prior to treatment. In light of the nonlexical reading route gains in the pilot study, we wanted to expand our understanding of the impact of Cool Reading on components of the nonlexical reading route. In the pilot study, we focused on GPC knowledge. However,

nonlexical reading also depends upon the ability to segment words into phonemes and blend phonemes into words. Hence, we added measures for phoneme segmentation and phoneme blending. We also added new measures of the lexical reading route (sight word reading and sight word spelling), and cognitive components of this route (phonological lexicon and semantics), to help clarify the mixed lexical route outcomes in the pilot study. Finally, we added measures for two cognitive components common to both the nonlexical and lexical reading routes: letter position encoding and phonological output. The measures that we used to assess all the reading outcomes are summarised in Table 1 and outlined in the Methods under the “Reading outcome measures” section.

The second aim of this interventional case series was to evaluate the effect of the revised version of Cool Reading on anxiety in poor readers. In the pilot study, children showed a remission rate for primary anxiety disorders of 0%, which fairs poorly compared to the Cool Kids programme (68%; Hudson, Rapee, Deveney, Schniering, Lyneham, & Bovopoulos, 2009). Across individual anxiety diagnoses, we discovered an overall remission rate of 33%. Children showed reductions in the clinical severity for social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, and specific phobias. In addition, two parents reported significant reductions in their child’s generalised anxiety symptoms and social anxiety symptoms, while one parent reported significant reductions in their child’s separation anxiety symptoms, physical injury fears, panic/agoraphobia symptoms, and total anxiety symptoms. Two parents also reported significant reductions in parent interference, and one parent reported reductions in home and outside-home interference. The remission rates across individual anxiety diagnoses, and reductions in anxiety symptoms, were promising. We therefore predicted that the revised version of Cool Reading would have a larger positive effect on anxiety disorders, anxiety symptoms, and anxiety interference.

Summary

To summarise, the general aim of this study was to test if a revised version of Cool Reading had significant and positive impacts on concomitant reading and anxiety problems in children. The specific aims of this study were to evaluate whether Cool Reading significantly improved general reading skills, nonlexical and lexical reading, and individual cognitive components of the nonlexical and lexical reading routes (Aim 1), as well as anxiety disorders, anxiety symptoms, and anxiety interference (Aim 2). In terms of reading, the results of our pilot study predicted significant gains in reading accuracy, in reading comprehension, in nonword reading accuracy and fluency and spelling, and in GPC knowledge. We were unable to predict the direction of outcomes for the lexical reading route or its cognitive components due to mixed findings in the pilot study. In terms of anxiety, the results of our pilot study predicted marked reductions in individual anxiety disorders, anxiety symptoms, and anxiety interference.

METHOD

Ethical consent

The Macquarie University Human Ethics Committee (Reference: 5201800419) approved the methods detailed below. Parents provided written consent for their children to participate in this study, and verbal consent was also obtained from children. Parent and children were advised that they could withdraw at any stage of the study without consequence.

Study design and procedures

The design and procedures of the current study were the same as the pilot study (Chapter 5), with the following exceptions. First, this interventional case series study included a double-baseline period comprising 12 weeks of no training. This was flanked by assessments immediately before (Test 1; T1) and after (Test 2; T2) the no training period, in

which children and parents completed the outcome measures (see Table 1). Second, during the intervention period, in addition to receiving weekly clinical supervision from JH (the third author of this thesis who is the Director of the Centre for Emotional Health), DF also received weekly clinical supervision from Dr Saskia Kohen (the Clinical Director of the Macquarie University Reading Clinic (MURC)) to discuss case formulation and individualisation of treatment. After the intervention, children and parents were administered the T1 and T2 reading and anxiety outcome measures a third time (Test 3; T3).

Recruitment

Children were recruited from the MURC and from the pool of children who had demonstrated poor reading and elevated levels of anxiety in Chapter 3. Children recruited from the MURC had previously been assessed but had not received treatment, were on a waitlist for treatment, or had siblings who had completed an assessment at the MURC and had heard about the study through word of mouth. We sent information and consent forms to 11 parents. All parents responded that they would like to participate. Hence, 11 children were initially assessed at T1 to participate in the study. However, one parent could not commit to the treatment requirements, and two children did not meet inclusion criteria (see below). One other participant completed the T1 and T2 assessments but withdrew from participation after six weeks of intervention. Hence, seven children completed all testing and treatment components of the study.

Inclusion criteria

The inclusion criteria for the current study were the same as those in the pilot study (Chapter 5). Specifically, children were between the age of 8 and 12 years and had poor word reading accuracy and anxiety. Poor word reading accuracy was identified by scores that were at least one standard deviation (≤ 1 SD) below the age mean on the Nonword Reading List or Irregular Word Reading List of the Castles and Coltheart Reading Test, 2nd Edition (CC2;

Castles et al., 2009; see “Recruitment measures” section below). Anxiety was identified by scores exceeding the clinical threshold (i.e., scores ≥ 4) of the clinician severity rating (CSR) for one or more anxiety disorders on the Anxiety Disorders Interview Schedule for Children and Parents (ADIS-C/P; Silverman & Albano, 1996; see “Recruitment measures”).

Exclusion criteria

Exclusion criteria for the current study were also the same as the pilot study (Chapter 5). Children with a history of severe behavioural issues, poor hearing, poor vision, neurological impairment, sensory impairment, and comorbid diagnoses (e.g., autism; see questionnaire in Appendix B in Chapter 3) were not included in the current study. Children were also excluded if they had emotional problems other than anxiety (e.g., depression) as measured using the ADIS-C/P (Silverman & Albano, 1996; see “Recruitment measures”).

Recruitment measures (T1)

Table 1 outlines the recruitment measures used in this study. These measures have all been described in previous chapters. To avoid repetition, the last column of Table 1 refers the reader to the relevant chapter for a description of each test.

Profiling measures (T1)

Table 1 outlines all the profiling measures used in this study. All these measures have been described in previous chapters. To avoid repetition, column four of Table 1 refers the reader to the relevant chapter for a description of each test.

Table 1

Cool Reading assessment measures and clinical tools with reference to the chapter it was introduced

Outcome	Clinical Tool	Reference	Ch.
Recruitment			
Nonword reading accuracy	Castles and Coltheart Reading Test, Second Edition (CC2)	Castles et al., 2009	3
Irregular reading accuracy	CC2	Castles et al., 2009	
Anxiety disorders	Anxiety Disorders Interview Schedule – child and parent report (ADIS-C/P)	Silverman & Albano, 1996	5
Profiling			
Reading self-concept	Reading Self-Concept Scale	Chapman & Tunmer, 1995	3
Peer problems	Strengths and Difficulties (SDQ-P)	Goodman, 1997	3
Peer relationships	Conner's questionnaire (Conner's-P)	Conners, 2008	5
Inattention	Conner's-P	Conners, 2008	5
Hyperactivity	Conner's-P	Conners, 2008	5
Combined inattention & hyperactivity	SDQ-P	Goodman, 1997	3
Conduct symptoms	SDQ-P	Goodman, 1997	3
Aggression & aggression	Conner's-P	Conners, 2008	5
Nonverbal cognitive ability	Kaufman Brief Intelligence Test 2 nd Edition (K-BIT-II)	Kaufman & Kaufman, 2004	5
Verbal cognitive ability	Clinical Evaluation of Language Fundamentals 4 th Edition (CELF)	Semel, Wiig, & Secord, 2003	5
Outcomes			
General reading			
Word reading accuracy	CC2	Castles et al., 2009	3
Word reading fluency	Test of Word Reading Efficiency (TOWRE)	Torgesen, Wagner, & Rashotte, 1999	3
Text reading fluency	Wheldall Assessment of Reading Passages (WARP)	Wheldall & Madeleine, 2000	5
Reading comprehension	Neale Analysis of Reading Ability 2 nd Edition (NARA)	Neale, 1999	5
Nonlexical reading route			
Nonword reading accuracy	CC2	Castles et al., 2009	3
Nonword reading fluency	TOWRE	Torgesen, Wagner, & Rashotte, 1999	3
Nonword spelling	Queensland Inventory of Literacy (QUIL)	Dodd, Holm, Oerlemans, & McCormick, 1996	3
Lexical reading route			
Irregular reading accuracy	CC2	Castles et al., 2009	3
Irregular word spelling	Diagnostic Spelling Test for Irregular Words (DiSTi)	Kohnen, Colenbrander, & Nickels, 2012	3
Sight word reading	MURC Sight Word Reading Test	Kohnen & Banales, 2015c	6
Sight word spelling	MURC Sight Word Spelling Test	Kohnen & Banales, 2015c	6
Common components of the nonlexical and lexical routes			
Letter identification	Cross-Case Copying	McArthur et al., 2013	5

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Letter position encoding	Letter Position Test (LetPos)	Kohnen, Marinus, Friedman, Anandakumar, Nickels, McArthur, Castles, 2012	6
Phonological output	Comprehensive Test of Phonological Processing (CToPP)	Wagner, Torgesen, & Rashotte, 1999	6
Components of the nonlexical reading route			
GPC knowledge	Letter Sound Test (LeST)	Larsen, Kohnen, Nickels, & McArthur, 2015	5
GPC knowledge	Diagnostic Reading Test (DiRT)	Colenbrander, Kohnen, & Nickels, 2011	5
PGC knowledge	Diagnostic Spelling Test – Nonwords (DiSTn)	Kohnen, Nickels, & Castles, 2009	5
Blending phonemes	CToPP	Wagner, Torgesen, & Rashotte, 1999	6
Segmenting phonemes	CToPP	Wagner, Torgesen, & Rashotte, 1999	6
Components of lexical reading route			
Orthographic lexicon	Test of Orthographic Choice (TOC)	Kohnen, Anandakumar, McArthur, & Castles, 2012	5
Orthographic-semantic link	Meaning of Written Words	Kohnen, Larsen, Jones, Castles, & McArthur, 2012	5
Phonological lexicon	Assessment of Comprehension and Expression (ACE)	Adams et al., 2001	6
Semantics	Squirrel Nut Test	Pitchford & Eames, 1994	6
Anxiety			
Anxiety disorders	ADIS-C/P	Silverman & Albano, 1996	5
Anxiety symptoms	Spence Children's Anxiety Scale- child and parent report (SCAS)	Spence, 1998	3
Anxiety symptoms	Social Phobia Anxiety Inventory - child and parent report (SPAI)	Beidel et al., 2000	3
Anxiety interference	Child Anxiety Life Interference Scale – child and parent report (CALIS)	Lyneham et al., 2013	3

Reading outcome measures (T1, T2, and T3)

At T1, T2, and T3, we administered tests to assess general reading skills, the nonlexical reading route, the lexical reading route, and the cognitive components of both routes. As shown in Table 1 (column four), many of these tests have already been described in previous chapters. Below we outline the reading measures that are new to this study and hence have not yet been described.

Lexical reading route

Trained reading sight words. The Sight Word Reading List, which was developed by researchers at the MURC (Kohnen & Banales, 2015c), measures children's knowledge of frequently read words. The test comprises 1,204 words ordered in frequency. Frequently read words are presented first (e.g., the) and less frequent words presented last (e.g., vegetable).

The clinician presents the child with a relevant word printed on a flashcard. The child reads the word aloud and the clinician records and scores the child's response for accuracy (1 = correct, 0 = incorrect). The test is stopped after the child reads a total of 30 words incorrectly. These 30 words are trained during Cool Reading and hence are retested at the T2 and T3 assessments. This is not a normed test, and there are no psychometric properties or test-retest reliability estimates available.

Trained spelling sight words. The Sight Word Spelling List was also developed by researchers at the MURC (Kohnen & Banales, 2015c). It measures children's knowledge for frequently spelled words. This test comprises 1,130 words ordered in frequency. Frequently spelled words are presented first (e.g., and) and less frequently spelled words are presented last (e.g., ocean). The clinician reads aloud a word one at a time and asks the child to write the word on the response sheet. The clinician scores the child's response for accuracy (1 = correct, 0 = incorrect). The test is stopped after the child spells a total of 30 words incorrectly. The 30 words are trained during Cool Reading and so are tested again at the T2 and T3 assessments. Again, this is not a normed test, and there are no psychometric properties or test-retest reliability estimates available for this test.

Components common to the nonlexical and lexical routes

Letter position encoding. The Letter Position Test (LetPos; Kohnen, Marinus, Friedmann, Anandakumar, Nickels, McArthur, & Castles, 2012) was used to measure letter position encoding. This test comprises 60 words that are "migratable", meaning that some letters can be moved to create a new word (e.g., "smile" can be read as "slime"). Children are asked to read two pages of words. There is no discontinue rule and so children read aloud all items. If the child does not respond to a word within 5 seconds, the clinician prompts the child to attempt the next word.

The clinician records the child's responses and scores items as correct (1) or incorrect (0). Incorrect responses may include migration errors (e.g., reading "smile" as "slime"), word errors (e.g., reading "smile" as "smell"), and other errors (e.g., reading "smile" as "smil"). The total number of correct responses are tallied. Raw scores are converted in z-scores ($M = 1$, $SD = 0$). In terms of cut-off criteria, a z-score below -1.00 indicates performance below the average range, a z-score from -1.0 to 1.0 indicates performance within the average range, and a z-score above 1.00 indicates performance above the average range. Normative data are based on New South Wales school children in Grades 3 to 6 who attended schools that performed the average range on national screening literacy measures (Kohnen et al., 2012). There are currently no psychometric properties available for this test.

Phonological output. The repetition of nonwords subtest from the Comprehensive Test of Phonological Processing (CToPP; Wagner, Torgesen, & Rashotte, 1999) was used to index the phonological output component. This test comprises 18 items that increase in difficulty (e.g., item 1: "jup"; item 18: "shaburiehuvomush"). Children listen to pre-recorded nonwords and are instructed to repeat the nonword exactly as they hear it. The items cannot be played more than once. The clinician records the children's responses and allocates scores for correct (1) and incorrect (0) nonword responses. Testing is discontinued after three consecutive errors. The raw scores are tallied and converted into scaled scores ($M = 10$; $SD = 3$). In terms of cut-off criteria, a score below 7 indicates performance below the average range, a score from 7 to 13 indicates performance within the average range, and a score above 13 indicates performance above the average range. The psychometric properties of the nonword repetition subtest are sound and the test-retest reliability estimate ranges from 0.75 to 0.92 (Wagner et al., 1999).

Components of the nonlexical reading route

Phoneme segmentation. This was measured with the segmenting nonwords subtest from the CToPP (Wagner et al. 1999). This test comprises 20 nonwords that increase in difficulty (e.g., item 1: “ta” and item 20: “shuligraij”). For each item, children are asked to repeat a recorded nonword and then segment the nonword into separate parts (e.g., “ta” becomes “t-a”). If a child repeats the nonword incorrectly, the word is presented until the child repeats the word correctly. The clinician records children’s responses and allocates scores for correct (1) and incorrect (0) segmentation. Children are administered items until they make three consecutive errors. The raw scores are tallied and converted into scaled scores. In terms of cut-off criteria, a score below 7 indicates performance below the average range, a score from 7 to 13 indicates performance within the average range, and a score above 13 indicates performance above the average range. Internal consistency for the segmenting subtest is sound (Cronbach’s $\alpha > 0.80$), as is the test-retest reliability ($r = 0.70$ to 0.92 ; Wagner et al., 1999).

Phoneme blending. This was indexed with the blending nonwords subtest from the CToPP (Wagner et al., 1999), which comprises 18 nonwords that increase in difficulty (e.g., item 1: moe-taib; item 18: t-a-s-t-ai-n-z). Children listen to a pre-recorded nonword that is separated into individual parts. Children are instructed to put the separated parts together to make a nonword (e.g., “moe-taib” becomes “moetaib”). Children are administered items in order until the child makes three consecutive errors. The clinician records responses verbatim and scores responses as correct (1) and incorrect (0). The raw scores are tallied and converted into scaled scores ($M = 10$, $SD = 3$). In terms of cut-off criteria, a score below 7 indicates performance below the average range, a score from 7 to 13 indicates performance within the average range, and a score above 13 indicates performance above the average range. The psychometric properties for the blending nonwords test are

sound for internal consistency (Cronbach's $\alpha = 0.89$) and test-retest reliability ($r = 0.75$ to 0.92 ; Wagner et al., 1999).

Components of the lexical route

Phonological lexicon. The picture naming subtest from the Assessment of Comprehension and Expression (ACE; Adams, Coke, Crutchley, Hesketh, & Reeves, 2001) was used to measure the phonological lexicon. The ACE comprises 25 picture items (e.g., a picture of a flower). The child is instructed to name each picture (e.g., "flower"). The clinician records the child's responses and are scored as correct (1) or incorrect (0). Children are administered all 25 items. Raw scores are tallied and converted to scaled scores ($M = 10$, $SD = 3$). In terms of cut-off criteria, a scaled score below 7 indicates performance below the average range, a score from 7 to 13 indicates performance within the average range, and a score above 13 indicates performance above the average range. In terms of psychometric properties, the picture naming subtest of the ACE has sound test-retest reliability ($r = 0.87$).

Semantic knowledge. The Squirrel Nut Test was used to measure semantic knowledge (Pitchford & Eames 1994). This test comprises 57 target pictures (e.g., a nut). Each target picture is paired with two additional pictures – one of which is a semantic match (e.g., squirrel) and one of which is a distractor (e.g., rabbit). The child is asked to select the picture (squirrel or rabbit) that matches the target picture (nut). The child selects their answer by pointing to the picture. The clinician records the child's responses and assigns correct responses a score of "1" and incorrect responses a score of "0". Raw scores are tallied and converted into z-scores ($M = 0$; $SD = 1$). In terms of cut-off criteria, a z-score below -1.00 indicates performance below the average range, a z-score from -1.00 to 1.00 indicates performance within the average range, and a z-score above 1.00 indicates performance above the average range. At present, there are no reported psychometric properties available for the Squirrel Nut Test.

Anxiety outcome measures (T1, T2, and T3)

At T1, T2, and T3, we administered tests to assess anxiety disorders (ADIS-C/P), anxiety symptoms (SPAI-C/P; SCAS-C/P), and anxiety interference (CALIS-C/P). As shown in Table 1, all of these anxiety outcomes have been described in previous chapters. Hence, to minimise repetition, we again refer the reader to previous chapters for details of these tests.

Cool Reading intervention

Reading

The reading profiles of all the children indicated that they all needed reading accuracy training. Thus the Cool Reading treatment components for reading were: MURC Reading Gap Training (Kohnen & Banales, 2015a), MURC Spelling Gap Training (Kohnen & Banales, 2015b), MURC Sight Word Reading Training (Kohnen & Banales, 2015c), MURC Sight Word Spelling Training (Kohnen & Banales, 2015d), and MURC Text Reading Accuracy Training. These reading treatments were also administered in the pilot study (see Chapter 5) and are described in Chapter 4.

The five reading treatments provided direct and indirect training for the reading outcomes. In terms of direct training, the five reading treatments targeted regular word reading accuracy, nonword reading accuracy, nonword spelling, GPC knowledge, sight word reading, and sight word spelling. Letter identification was directly trained for six children (ZK, YR, CG, RF, JA, FM) and indirectly trained for one child (CL). In terms of indirect training, the four reading treatments targeted letter position encoding, phonological output, phoneme blending, and phoneme segmentation. The treatments did not include direct or indirect training for word reading fluency, text reading fluency, reading comprehension, nonword reading fluency, the orthographic-semantics link, the phonological lexicon, or semantics knowledge. Tables 4 to 9 in the “Results” section compare the types of reading treatment received by each child to their reading outcomes.

Anxiety

In the current study, all children received the core anxiety treatment components of Cool Reading. Five children also completed one or more of the specific additional treatment components. Specifically, YR completed Structured Problem Solving, CG completed Progressive Muscle Relaxation, and three children completed Social Skills and Confidence and Dealing with Bullying components (RF, JA, FM). Tables 10 to 14 compare the types of anxiety treatment received by each child to their anxiety outcomes.

RESULTS**Profiles**

We integrated the recruitment assessments (see Table 2) with the profiling assessments (see Table 3) to understand the profiles of the children in this study. We report children's profiles in two ways. First, we consider the profile of the seven children as a group, and then we consider their profiles individually. In line with previous chapters, we used parent responses on anxiety questionnaires since children with anxiety disorders tend to under-report anxiety symptoms (Schniering, Hudson, & Rapee, 2000), and parents have more reliable responses on anxiety questionnaires than children under 13 years (Grills & Ollendick, 2003; Rapee, Barrett, Dadds, & Evans, 1994; Note: we provide the outcomes for the child-report questionnaire data in Appendix A).

Group profile

Three girls (CL, ZK, YR) and four boys (CG, RF, JA, FM) met the criteria for this study. As a group, children presented with mixed reading difficulties. All children performed at least 1 SD below the age mean for nonword reading accuracy and irregular word reading accuracy. Four children met criteria for a primary diagnosis of social anxiety disorder (CL, CG, RF, FM), two children met criteria for a primary diagnosis of generalised anxiety disorder (YR, JA), and one child met criteria for a primary diagnosis of separation anxiety

disorder (ZK). It is noteworthy that JA was diagnosed with social anxiety disorder at T2 but not at T1. Three children were diagnosed with separation anxiety disorder (ZK, CG, RF), and six children were diagnosed with one or more specific phobias (CL, ZK, YR, CG, RF, FM). Six children reported significant and interfering worries related to reading (e.g., reading aloud, asking for help; CL, ZK, CG, RF, JA, FM) while one child only reported significant general worries and specific phobias (YR).

Table 2
Children's scores at T1 on the recruitment measures

	CL	ZK	YR	CG	RF	JA	FM
Reading							
Nonword reading accuracy (CC2; z-scores) ^a	-2.31	-1.06	-1.93	-2.37	-1.25	-2.29	-1.20
Irregular reading accuracy (CC2; z-scores) ^a	-2.12	-2.51	-2.16	-1.87	-2.00	-1.63	-2.08
Anxiety							
Social anxiety disorder (ADIS-C/P; CSR) ^b	6	6	ND	5	6	ND	5
Generalised anxiety disorder (ADIS-C/P; CSR) ^b	5	ND	4	4	4	4	4
Separation anxiety disorder (ADIS-C/P; CSR) ^b	ND	6	ND	4	5	ND	ND
Specific phobias (ADIS-C/P; CSR) ^b	Spiders: 4 Dark: 4 Clowns: 4 Doctor: 4	Wasps: 5 Loud noises: 5 Spiders: 4 Lifts: 4 Toilets: 4	Dogs: 4 Lifts: 4 Insects: 4 Dentist: 4 Dark: 4 Blood: 4 Spiders: 4	Heights: 4 Planes: 4	Dark: 4	ND	Spiders: 4 Heights: 4

Note. ^aLow scores indicate poor performance. ^bHigh scores indicate poor performance. ND = not diagnosed. Grey cells indicate primary anxiety disorder.

Table 3 presents children's scores for the profiling measures. As a group five children performed at least 1 SD below the age mean for reading self-concept (CL, ZK, YR, JA, FM) and two performed within the average range (CG, RF). Four children had elevated scores on both measures of peer relation problems (CL, RF, JA, FM), while three performed within the

average range for peer relations (ZK, YR, CG). In terms of attention, five children reported inattention problems (CL, ZK, CG, JA, FM) while two children performed within the average range (YR, RF). Three children reported hyperactivity problems (CL, ZK, JA) while four children performed within the average range (YR, CG, RF, FM). Five children reported combined hyperactivity and inattention problems (CL, ZK, CG, JA, FM) while two children performed within the average range (YR, RF). In terms of behaviour, only two children reported poor behaviour on defiance and aggression (CL, FM) while all other children remained within the average range for both measures of behaviour problems (ZK, YR, CG, RF, JA). In terms of general cognitive skills, two children performed below average for verbal cognitive skills (CG, JA) while five children performed within the average range (CL, ZK, YR, RF, FM). For nonverbal skills, one child performed just within the average range (RF), while six children performed within the average range (CL, ZK, YR, CG, JA, FM).

Table 3
Children's scores on the profiling measures at T1

	CL	ZK	YR	CG	RF	JA	FM
Reading self-concept measure							
Reading self-concept (RSCS; raw scores ≤ 3.18) ^a	2.76	3.10	2.60	3.23	3.63	2.96	3.00
Peer relations measures							
Peer problems (SDQ-P; raw scores ≥ 3.5) ^b	5	0	3	2	5	4	4
Peer relationships (Conners-P; T-scores ≥ 65) ^b	90	45	52	53	81	90	90
Attention measures							
Inattention (Conners-P; T-scores ≥ 65) ^b	75	71	55	81	55	68	75
Hyperactivity (Conners-P; T-scores ≥ 65) ^b	90	67	53	57	59	90	62
Hyperactivity & inattention (SDQ-P; raw scores ≥ 5.5) ^b	8	7	5	7	3	9	8
Behaviour measures							
Conduct symptoms (SDQ-P/raw scores ≥ 3.1) ^b	3	1	1	1	0	2	2
Defiance and aggression (Conners-P/T-scores ≥ 65) ^b	90	44	53	44	46	54	67
Cognitive ability							
Verbal cognitive ability (CELF-4; scaled scores ≤ 7) ^a	13	9	9	6	11	5	9
Nonverbal cognitive ability (KBIT-2; standard scores ≤ 85) ^a	97	105	103	113	88	100	95

Note. ^aLow scores indicate poor performance. ^bHigh scores indicate poor performance. Bolded scores are clinically elevated according to cut-off scores which are listed in the first column.

Individual profiles

CL. CL presented for her T1 assessment in August, 2018. CL was aged 10 years and 3 months, and attended Grade 5 (Term 3) at a private school in Sydney. At T1, CL presented with mixed reading difficulties and performed more than 1 SD below the mean age for nonword and irregular word reading accuracy. In terms of anxiety, CL was diagnosed with a primary disorder of social anxiety disorder. She also met criteria for generalised anxiety disorder and specific phobias (doctors, clowns, spiders). CL reportedly experienced difficulties answering questions in class, reading aloud, eating in front of others, working and playing in a group, and interacting with people. She reported substantial worries about being teased and bullied. These difficulties occurred within the context of poor reading self-concept and elevated peer relation problems, attention problems, and behaviour problems. She demonstrated average nonverbal cognitive skills and high average verbal cognitive skills. In terms of previous intervention, CL had received treatment for reading but not anxiety.

ZK. ZK completed her T1 assessment in August, 2019. ZK was aged 8 years and 0 months. She attended Grade 2 (Term 3) at home-school. ZK was removed from mainstream school by her parents because of a parental belief that her reading difficulties were not addressed in the classroom. Her reading difficulties segregated her from her classmates which impacted her confidence, her friendships, and family life. In terms of reading, ZK presented with mixed reading difficulties and performed at least 1 SD below the mean for her age for nonword and irregular word reading accuracy. In terms of anxiety, ZK received a primary diagnosis of separation anxiety disorder. She also met criteria for social anxiety disorder and specific phobias (spiders, elevators, loud noises, bees and wasps, dentist/doctor, toilets). The most interfering worries for ZK were related to separation anxiety disorder, as well as the threat of negative evaluation and making mistakes. She reported physical symptoms such as stomach aches and body tightness. These difficulties occurred within the context of poor

reading self-concept and elevated attention problems. She demonstrated average nonverbal cognitive skills, verbal cognitive skills, peer relations, and behaviour. In terms of previous intervention, ZK had received two years of reading treatment, but no treatment for anxiety. She did not receive any additional treatment for reading or anxiety throughout this study.

YR. YR completed her T1 assessment in August, 2018. YR was aged 9 years and 0 months and attended Grade 3 (Term 3) at a public school in Sydney. YR presented with profound mixed reading difficulties. On the tests of reading accuracy, YR performed more than 1 SD below the age average on the test of nonword reading accuracy and irregular word reading accuracy. YR's T1 assessment was divided into two separate sessions due to her slow responses. In terms of anxiety, YR was diagnosed with a primary disorder of generalised anxiety disorder. She also met criteria for seven specific phobias (dogs, lifts, insects, dentists, dark, blood, spiders). YR and her mother also reported separation worries but these did not meet criteria for a diagnosis of separation anxiety disorder. The most interfering worries for YR included worries about friendships, the future, and things going on in the world. Interestingly, YR did not report many school-related worries despite being segregated from her classmates as a consequence of her reading difficulties. Throughout Grade 4, YR was seated at an individual desk facing the window away from her classmates because she could not access the school curriculum because of her reading difficulties. YR was extremely motivated to improve her reading skills to join her classmates. In terms of her general profile, YR reported poor reading self-concept. Her nonverbal cognitive skills, verbal cognitive skills, behaviour, attention, and peer relationships were all within the average range. In terms of previous treatment, YR had received treatment for reading and anxiety. It is noteworthy that YR has previously attempted the Cool Kids programme with a private psychologist. According to her mother, YR discontinued the program after four sessions because "she could not read" and hence "could not access the program." YR's mother reported that this

was very upsetting for YR because “she does not want to be anxious.” In the present study, YR did not receive any additional treatment for reading or anxiety during this study.

CG. CG completed his T1 assessment in August, 2018. CG was aged 8 years and 11 months old. He attended Grade 3 (Term 3) at a public school in Sydney. At T1, CG presented with profound reading difficulties that placed him more than 1 SD below age average on tests of nonword and irregular word reading accuracy. In terms of anxiety, CG met criteria for a primary diagnosis of social anxiety disorder. He also met criteria for separation anxiety disorder, generalised anxiety disorder, and two specific phobias (heights, planes). CG reported significant worries at school (e.g., speeches, reading aloud, tests, writing on the board) and separation worries (e.g., being away from her mother and home, getting lost, something bad happening to his family). He also reported physical symptoms (e.g., nausea, turning pale, shaking) and difficulties sleeping. His mother reported that she often collected CG from school during early because of his physical symptoms. In addition to these difficulties, CG reported inattention problems and below average verbal cognitive ability. His nonverbal cognitive skills, reading self-concept, peer relationships, behaviour, and hyperactivity were within the average range. In terms of previous intervention, CG had received treatment for reading but not anxiety. He did not receive any additional treatment throughout this study.

RF. RF completed his T1 assessment in September, 2018. RF was aged 9 years and 5 months and attended Grade 3 (Term 3) at a public school on the mid-north coast of New South Wales. RF presented with mixed reading difficulties. On the tests of reading accuracy, RF performed more than 1 SD below average for nonword reading accuracy and irregular word reading accuracy. In terms of anxiety, RF was diagnosed with a primary disorder of social anxiety disorder. He also met criteria for generalised anxiety disorder, separation anxiety disorder, and one specific phobia (the dark). RF’s most interfering worries were

related to social situations (e.g., reading aloud, writing on the board, eating in front of people, joining a conversation with his peers, and answering questions in the classroom). He also reported physical symptoms (e.g., stomach ache, crying). In addition to these difficulties, RF reported elevated peer relationship problems. His verbal cognitive skills, nonverbal cognitive skills (just), reading self-concept, attention, and behaviour were within the average range. In terms of previous intervention, RF had received treatment for reading but not anxiety. He did not receive additional treatment for the duration of the study.

JA. JA completed his T1 assessment in September, 2018. JA was aged 8 years and 5 months. He was attending Grade 2 (Term 3) at a public school in Western Sydney. At T1, JA presented with profound and severe mixed reading difficulties. Specifically, JA performed more than 1 SD below the age mean for nonword reading accuracy and irregular word reading accuracy. In terms of anxiety, JA was diagnosed with a primary disorder of generalised anxiety disorder. At T2, his mother reported that JA's anxiety had significantly increased and he also met criteria for social anxiety disorder (Note: These diagnoses were made on the parent report only as JA appeared to be unreliable reporting his own anxiety as judged by both DF and LM). His most interfering worries included meeting new people, reading aloud, trying new things, and asking for help. He experienced significant difficulties sleeping. These difficulties occurred within the context of poor reading self-concept, elevated peer relationship problems, elevated attention problems, and below average verbal cognitive skills. His nonverbal cognitive skills and behaviour were within the average range. In terms of previous treatment, JA had received treatment for reading but not anxiety. JA did not receive any additional treatment for his reading or anxiety throughout the study.

FM. FM completed his initial T1 assessment in September, 2019. FM was aged 9 years and 2 months, and was attending Grade 3 (Term 4) at a public school in South-West Sydney. At T1, FM presented with mixed reading difficulties. He performed more than 1 SD

below average for his age for nonword and irregular word reading accuracy. In terms of anxiety, FM was diagnosed with a primary disorder of social anxiety disorder. He also met criteria for generalised anxiety disorder and two specific phobias (heights, spiders). FM reported numerous school related worries (e.g., answering questions in class, reading aloud, asking for help, taking tests, writing on the board, standing up for himself, being bullied). His mother also reported FM had been on the receiving end of ongoing weekly and severe bullying in the school playground. FM showed visible signs of anxiety during his T1 assessment. He was extremely reluctant to commence the session, and so this assessment was split over two testing sessions to allow FM and the therapist to develop rapport. In addition to these difficulties, FM also reported poor reading self-concept, peer problems, attention problems, and behaviour problems. His nonverbal and verbal cognitive skills were within the average range. FM had received previous treatment for reading but not anxiety. He did not receive any additional treatment throughout the study.

Cool Reading outcomes

Data analyses

The first aim of this study was to evaluate the effectiveness of our updated version of Cool Reading on reading outcomes for poor readers with anxiety. In this case series we calculated weighted statistics (WEST) to determine whether there was a statistically significant and reliable change in reading outcomes across the treatment period (Howard, Best, Nickels, 2015). Weighted statistics were developed to analyse dichotomous data in single case studies with multiple testing points. These statistics evaluate whether there is a change in the probability correct for each individual item of a test for each individual child. The statistics compare the change in probability of scores correct from T1 to T3 and the change in probability correct over the baseline period (T1 and T2).

To calculate the weighted statistics, we followed the methods prescribed by Howard and colleagues (2015). First, we evaluated an overall trend for improvement at the group level (i.e., WEST-Trend). The WEST-Trend was calculated to evaluate overall change in reading outcomes over the entire study period (i.e., T1, T2, T3). Second, we evaluated whether there was a significantly greater rate of change during the treatment period (T2 to T3) compared to the baseline period (T1 to T2) at the group level using WEST rate of change (WEST-ROC). To calculate the WEST-Trend and WEST-ROC at the group level, we analysed the raw scores for the reading outcomes across each timepoint. The raw scores are multiplied by a weight at each test point, and the weighted scores are tallied and analysed using a one-sample *t*-test. We adhered to an alpha level of .05. To show a significant intervention effect, we needed to show a significant WEST-Trend and significant WEST-ROC effect.

In addition to the group level statistics, we wanted to investigate change at the individual level to determine if each child showed a significant treatment effect. We therefore calculated WEST-Trend and WEST-ROC statistics at the individual level using a weighted by-item analysis for each child's performance for each reading outcome following the procedures prescribed by Howard and colleagues (2015). First, children's performance on each test are analysed individually. The individual items on each test, for each time point, are assigned a dichotomous rating of correct (e.g., a score of 1) or incorrect (e.g., a score of 0) at the individual item level. Each test item is compared against its own score at T1, T2, and T3 and multiplied by a weight. A weighted score is then calculated for each item. The weighted item scores are then tallied. The set of tallied weighted scores are then analysed using a one-sample *t*-test. At the individual level, a significant one-tailed *t*-test suggests that the amount of improvement during the intervention (T2 and T3) is significantly different to the improvement during the baseline period (T1 and T2).

We conducted the weighted by-item analysis for 11 outcome measures that administered all test items (trained spelling sight words, trained reading sight words, letter identification, letter position encoding, GPC knowledge for individual graphemes, GPC knowledge for nonword reading, PGC knowledge for nonword spelling, orthographic lexicon, orthographic-semantics link, expressive vocabulary, semantics), and 10 outcomes that used a discontinue rule (regular reading accuracy, word reading fluency, text reading fluency, reading comprehension, nonword reading accuracy, nonword reading fluency, nonword spelling, irregular reading accuracy, irregular word spelling, phonological output, phonological processing). It is important to discriminate between these two groups of tests because the weighted by-item analysis presumes that an outcome measure administers all items at all test points (T1, T2, and T3). This was not the case for the latter group of measures which all used a discontinue rule. Discontinue rules are employed for practical and ethical reasons. Practically, discontinue rules improve the efficiency of testing by presenting items in order of difficulty which allow testing to be stopped when a child reliably demonstrates that they have hit their limit of ability by failing numerous items in a row. Ethically, discontinue rules are important for children since they minimise (1) testing time, and (2) exposing children to large amounts of repeated failure – a particular concern for poor readers with anxiety. It is for these reasons that this study decided to retain the discontinue rule for the latter group of tests and make the critical assumption that all children would have failed all items that fell beyond the point where their performance was discontinued in each test. This assumption allowed us to protect the wellbeing of the children as well as carry out weighted by-item analyses for all reading outcomes.

The second aim of this study was to evaluate the effectiveness of Cool Reading on anxiety outcomes (anxiety disorders, anxiety symptoms, anxiety interference). To examine effects at the group level, we calculated repeated measures ANOVAs to evaluate significant

differences in anxiety outcomes across the group of children at T1, T2, and T3. We used paired samples *t*-tests to follow up significant differences across time, with significant reductions in anxiety from T2 to T3 compared to reductions in anxiety from T1 to T2 considered to reflect a significant effect of the treatment.

We examined changes in disorder status for each child by evaluating the remission rates of disorders. We compared the T2 and T3 anxiety disorder score to a clinical cut off (e.g., clinician severity ratings less than 4) to identify the percentage of children who shifted from above the clinical threshold prior to intervention (T1, T2) to below the clinical threshold after intervention (T3). Specifically, we evaluated remission rates for children who did not meet diagnostic criteria for their primary anxiety diagnosis at T3 compared to T1 and T2 (i.e., the primary diagnosis is the child's most severe and interfering anxiety disorder) and remission rates for all anxiety disorders (see Tables 8 to 10).

For anxiety symptoms and anxiety interference, we conducted an adjusted reliable change index (RCI) calculation on the advice of our statistical advisor (see Appendix B). Specifically, we calculated a baseline adjusted change score ($[T3-T2 - [T2-T1]]$) and compared this to a critical value that indicated whether there was a significant change in scores across the treatment period compared to the baseline period. This baseline adjusted change (BAC) calculation has three assumptions: (1) there are three measurements - two baseline measurements (T1, T2) and one post-treatment measurement (T3); (2) the change between T1 and T2 test-retest reflects multiple non-intervention effects including test-retest effects, maturation effects, and some placebo effect; (3) the datasets are reasonably normally distributed; and (4) when a test-retest reliability is absent, it is (very conservatively) assumed to be zero. Similar to the RCI approach, the BAC score is compared to a critical value. The critical value is calculated using the test-retest reliability estimate of the measure and the standard deviation of the normative sample (see Appendix B for the mathematics underlying

this approach). The critical values for the baseline adjusted change scores represent how large the change must be in order to fall outside of the 95% confidence interval that would be expected if there were no effects of the intervention. Specifically, it estimates how much larger the change from T2 to T3 was relative to the change from T1 to T2. We report the one-tailed critical values at the alpha level of .05.

Reading outcomes

General reading. The raw scores and weighted statistics for the outcome measures for general reading are shown in Table 4. This table also indicates if each child received training for skills that are indexed by each outcome measure. As a group, children showed a significant treatment effect for regular word reading accuracy. Children also showed significant overall improvements for word reading fluency, text reading fluency, and reading comprehension. Individually, CL significantly improved on regular reading accuracy, word reading fluency, and text reading fluency, but not reading comprehension. ZK significantly improved on regular reading accuracy, word reading fluency, text reading fluency, and reading comprehension. YR significantly improved on word and text reading fluency, but not regular reading accuracy or reading comprehension. CG significantly improved on regular reading accuracy, word reading fluency, and text reading fluency, but not reading comprehension. RF significantly improved on reading comprehension, regular reading accuracy, and word reading fluency, but not text reading fluency. JA significantly improved on reading comprehension and text reading fluency, but not regular reading accuracy or word reading fluency. FM significantly improved on regular reading accuracy, text reading fluency, and reading comprehension but not word reading fluency.

In sum, all children were trained for word reading accuracy but not reading fluency or reading comprehension. In line with this, at the group level, there was a significant treatment effect for regular word reading accuracy but not reading fluency or comprehension. At the

individual level, significant treatment effects were observed for regular word reading accuracy in three children (CL, ZK, FM), for word reading fluency in one child (CL), for text reading fluency in one child (CL), and for reading comprehension in one child (RF).

Table 4

Raw scores and WEST-ROC and WEST-TREND results for general reading outcomes, with an indication of whether each outcome was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	M (SD)
Regular word reading accuracy (CC2; raw scores /40)	T1	16	16	16	3	16	15	16	14.00 (4.86)
	T2	17	18	20	7	20	12	8	14.57 (5.53)
	T3	27	28	18	14	23	19	15	20.57 (5.56)
	WEST-ROC	*	*	ns	ns	ns	ns	*	<i>t</i> (6) = 2.00, <i>p</i> < .05
	WEST-Trend	*	*	ns	*	*	ns	ns	<i>t</i> (6) = 3.44, <i>p</i> < .01
	Trained	✓	✓	✓	✓	✓	✓	✓	
Word reading fluency (TOWRE; raw scores /104)	T1	34	20	14	33	37	37	29	29.14 (8.90)
	T2	35	25	16	37	42	36	31	31.71 (8.71)
	T3	46	29	20	40	45	43	34	36.71 (9.59)
	WEST-ROC	*	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 1.36, <i>p</i> > .05
	WEST-Trend	*	*	*	*	*	ns	ns	<i>t</i> (6) = 8.45, <i>p</i> < .001
	Trained	X	X	X	X	X	X	X	
Text reading fluency (WARP; total words correct / 600)	T1	139	37	29	115	139	113	81	93.29 (45.63)
	T2	164	59	36	78	139	125	101	100.29 (45.65)
	T3	250	77	41	200	148	134	117	138.14 (70.80)
	WEST-ROC	*	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 1.33, <i>p</i> > .05
	WEST-Trend	*	*	*	*	ns	*	*	<i>t</i> (6) = 3.06, <i>p</i> < .01
	Trained	X	X	X	X	X	X	X	
Reading comprehension (NARA; raw scores /44)	T1	12	2	4	12	10	6	6	7.43 (3.95)
	T2	12	9	4	10	10	9	10	9.14 (2.48)
	T3	11	10	4	12	18	10	13	11.14 (4.18)
	WEST-ROC	ns	ns	ns	ns	*	ns	ns	<i>t</i> (6) = 0.17, <i>p</i> > .05
	WEST-Trend	ns	*	ns	ns	*	*	*	<i>t</i> (6) = 2.44, <i>p</i> < .05
	Trained	X	X	X	X	X	X	X	

Note. Significant effects (*p* < .05) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Nonlexical reading route. Table 5 shows the raw scores, weighted statistics, and training information related to each nonlexical-route outcome measure. As a group, children showed significant treatment effects for nonword reading accuracy and nonword spelling. There were no significant improvements for nonword reading fluency. Individually, CL significantly improved on nonword accuracy, fluency, and spelling. ZK significantly improved on nonword accuracy, fluency, and spelling. YR significantly improved on nonword reading accuracy, but not nonword fluency or spelling. CG significantly improved on nonword accuracy and fluency, but not nonword spelling. RF significantly improved on nonword accuracy, fluency, spelling. JA significantly improved on nonword accuracy and

spelling. FM significantly improved on nonword accuracy and nonword spelling, but not nonword reading fluency.

In sum, all children were trained for nonword reading accuracy and spelling but not nonword reading fluency. Aligned with this, at the group level, there was a significant treatment effect for nonword reading accuracy and nonword spelling accuracy but not reading fluency. Individually, significant treatment effects were demonstrated by four children for nonword reading accuracy (CL, CG, RF, FM), by two children for nonwords spelling (CL, ZK), and by two children for nonword reading fluency (CG, ZK).

Table 5
Raw scores and WEST-ROC and WEST-TREND results for nonlexical reading route outcomes, with an indication of whether each outcome was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	M (SD)
Nonword reading accuracy (CC2; raw scores /40)	T1	7	8	4	0	10	1	11	5.86 (4.30)
	T2	8	13	10	0	9	2	3	6.43 (4.79)
	T3	26	27	9	13	17	7	11	15.71 (8.01)
	WEST-ROC	*	ns	ns	*	*	ns	*	<i>t</i> (6) = 2.76, <i>p</i> < .05
	WEST-Trend	*	*	*	*	*	*	*	<i>t</i> (6) = 3.57, <i>p</i> < .01
	Trained	✓	✓	✓	✓	✓	✓	✓	
Nonword reading fluency (TOWRE; raw scores /63)	T1	4	11	9	4	7	2	9	6.57 (3.31)
	T2	8	5	10	3	13	5	11	7.86 (3.67)
	T3	13	10	8	11	11	3	7	9.00 (3.32)
	WEST-ROC	ns	*	ns	*	ns	ns	ns	<i>t</i> (6) = -0.05, <i>p</i> > .05
	WEST-Trend	*	ns	ns	*	*	ns	ns	<i>t</i> (6) = 1.49, <i>p</i> > .05
	Trained	X	X	X	X	X	X	X	
Nonword spelling accuracy (QUIL; raw scores /24)	T1	1	1	5	0	3	0	6	2.29 (2.43)
	T2	0	2	4	0	3	1	5	2.14 (1.95)
	T3	4	6	5	1	7	1	8	4.71 (2.56)
	WEST-ROC	*	*	ns	ns	ns	ns	ns	<i>t</i> (6) = 3.99, <i>p</i> < .01
	WEST-Trend	*	*	ns	ns	*	*	*	<i>t</i> (6) = 3.74, <i>p</i> < .01
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects (*p* < .05) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Lexical reading route. Table 6 shows the raw scores, weighted statistics, and training information related to each lexical-route outcome measure. As a group, there were significant treatment effects for irregular word spelling and trained spelling sight words, and an overall significant improvement for trained reading sight words. At the individual level, CL significantly improved on irregular word spelling, spelling sight words, and reading sight

words but not irregular reading accuracy. ZK significantly improved on irregular word spelling, reading sight words, spelling sight words, and irregular word reading accuracy. YR significantly improved on spelling sight words, reading sight words, and irregular word reading accuracy but not irregular word spelling. CG significantly improved on irregular word spelling, spelling sight words, and reading sight words but not irregular reading accuracy. RF significantly improved on spelling sight words, reading sight words, and irregular word spelling but not irregular reading accuracy. JA significantly improved on spelling sight words, reading sight words, irregular word spelling, and irregular reading accuracy. FM significantly improved on spelling sight words, and reading sight words but not irregular reading accuracy or irregular word spelling.

In sum, all children were trained for reading and spelling irregular words and sight words. At the group level, there was a significant treatment effect for spelling irregular and sight words but not reading irregular words or sight words. Individually, significant treatment effects were demonstrated by four children for irregular word spelling (CL, ZK, CG, RF), all children for trained spelling sight words, and two children for trained reading sight words (ZK, YR).

Table 6

Raw scores and WEST-ROC and WEST-TREND results for the lexical reading route outcomes, with an indication of whether each outcome was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	Group M (SD)
Irregular word reading accuracy (CC2; raw scores /40)	T1	7	1	4	8	11	7	7	6.43 (3.15)
	T2	10	5	6	12	12	11	8	9.14 (2.85)
	T3	7	4	7	9	8	11	5	7.29 (2.36)
	WEST-ROC	ns	ns	ns	ns	ns	ns	ns	$t(6) = -6.36, p > .05$
	WEST-Trend	ns	*	*	ns	ns	*	ns	$t(6) = 0.85, p > .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Irregular word spelling (DiSTi; raw scores /74)	T1	7	3	1	2	12	0	7	4.57 (4.28)
	T2	8	3	1	2	7	1	8	4.29 (3.25)
	T3	14	6	1	6	12	2	8	7.00 (4.80)
	WEST-ROC	*	*	ns	*	*	ns	ns	$t(6) = 2.07, p < .05$
	WEST-Trend	*	*	ns	*	ns	*	ns	$t(6) = 2.56, p < .02$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Sight word spelling (MURC; raw scores /30)	T1	0	0	0	0	0	0	0	0.00 (0.00)
	T2	6	7	0	6	6	3	5	22.14 (6.34)
	T3	25	25	10	25	25	17	28	6.57 (3.31)
	WEST-ROC	*	*	*	*	*	*	*	$t(6) = 12.80, p < .001$
	WEST-Trend	*	*	*	*	*	*	*	$t(6) = 9.25, p < .001$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Sight word reading (MURC; raw scores /30)	T1	0	0	0	0	0	0	0	0.00 (0.00)
	T2	17	2	7	14	14	10	15	11.29 (5.28)
	T3	27	28	24	25	27	26	28	26.43 (1.51)
	WEST-ROC	ns	*	*	ns	ns	ns	ns	$t(6) = 0.97, p > .05$
	WEST-Trend	*	*	*	*	*	*	*	$t(6) = 46.25, p < .001$
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Components common to the nonlexical and lexical routes. Table 7 shows the raw scores, weighted statistics, and training information related to the cognitive components that are common to both the nonlexical and lexical reading routes. Six of the seven children were trained for letter identification. Children were not trained in letter position encoding or phonological output specifically, but the other types of training the children received did engage these skills to various degrees. Thus, they have been trained indirectly. As a group, there were no significant improvements for letter identification, letter position encoding, or phonological output. Individually, significant treatment effects were demonstrated by three

children for letter position encoding (ZK, YR, CG), and one child for phonological output (RF).

Table 7

Raw scores and WEST-ROC and WEST-TREND results for the common components of the nonlexical and lexical reading routes, with an indication of whether each component was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	Group M (SD)
Individual components of both routes									
Letter identification (CCC; raw scores /14)	T1	13	13	11	14	14	10	14	12.86 (1.68)
	T2	14	12	12	12	14	11	13	12.57 (1.13)
	T3	14	14	9	14	14	12	14	13.00 (1.91)
	WEST-ROC	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 0.56, <i>p</i> > .05
	WEST-Trend	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 0.23, <i>p</i> > .05
	Trained	X	✓	✓	✓	✓	✓	✓	
Letter position encoding (LetPos; raw scores / 60)	T1	11	19	12	11	15	14	13	13.14 (3.44)
	T2	13	16	2	7	13	14	16	11.71 (5.06)
	T3	19	27	8	11	14	13	12	14.43 (6.70)
	WEST-ROC	ns	*	*	*	ns	ns	ns	<i>t</i> (6) = 1.45, <i>p</i> > .05
	WEST-Trend	*	*	ns	ns	ns	ns	ns	<i>t</i> (6) = 0.77, <i>p</i> > .05
	Trained (indirect)	✓	✓	✓	✓	✓	✓	✓	
Phonological output (CTOPP nonword repetition; raw scores / 18)	T1	10	9	11	8	8	5	8	8.43 (1.90)
	T2	12	8	12	9	5	3	9	8.29 (3.35)
	T3	11	6	10	9	11	5	8	8.57 (2.37)
	WEST-ROC	ns	ns	ns	ns	*	ns	ns	<i>t</i> (6) = 0.25, <i>p</i> > .05
	WEST-Trend	ns	ns	ns	ns	*	ns	ns	<i>t</i> (6) = 0.20, <i>p</i> > .05
	Trained (indirect)	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects (*p* < .05) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Components of the nonlexical route. Table 8 shows the raw scores, weighted statistics, and training information related to the cognitive components in the nonlexical reading route. As a group, there were significant treatment effects for GPC knowledge for individual graphemes, GPC knowledge for nonword reading, and PGC knowledge for nonword spelling. Individually, CL showed significant improvements on GPC knowledge for graphemes and nonword reading and nonword spelling, as well as phonological processing (segmenting but not blending). ZK showed significant improvements on GPC knowledge for graphemes and nonword reading and nonword spelling, but not phonological processing. YR showed significant improvements for only PGC knowledge for nonword spelling and

phonological processing (nonword segmenting). CG showed significant improvements on GPC knowledge for graphemes, nonword reading, and nonword spelling, as well as phonological processing (nonword segmenting). RF showed significant improvements on GPC knowledge for graphemes, nonword reading, and nonword spelling, but not on phonological processing. JA showed significant improvements on GPC knowledge for graphemes, nonword reading, and nonword spelling, and phonological processing (nonword blending). FM showed significant improvements for GPC knowledge for graphemes, reading, and spelling, and phonological processing (nonword blending only).

In sum, all children received training in reading and spelling GPCs individually or within nonwords, which included phoneme blending and phoneme segmentation. At the group level, there were significant treatment effects for the GPC/PGS outcome measures, but not phoneme blending or segmentation. Individually, significant treatment effects were demonstrated by four children GPC knowledge for individual graphemes (ZK, CG, JA, FM), by four children for GPC knowledge for nonword reading (CL, ZK, CG, FM), by all children for nonword spelling, and by two children for phoneme segmentation (CL, CG).

Table 8

Raw scores and WEST-ROC and WEST-TREND results for the components of the nonlexical route, with an indication of whether each component was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	Group M (SD)
GPC knowledge for individual graphemes (LeST; raw scores /51)	T1	38	34	27	28	36	26	31	31.43 (4.69)
	T2	42	35	29	29	39	25	34	33.29 (6.02)
	T3	47	50	33	43	46	37	45	42.86 (5.87)
	WEST-ROC	ns	*	ns	*	ns	*	*	$t(6) = 3.52, p < .01$
	WEST-Trend	*	*	ns	*	*	*	*	$t(6) = 8.09, p < .001$
	Trained	✓	✓	✓	✓	✓	✓	✓	
GPC knowledge for nonword reading (DiRT; raw scores /71)	T1	10	18	11	0	15	1	20	10.71 (7.83)
	T2	13	16	11	1	16	4	9	10.00 (5.77)
	T3	37	40	12	9	24	7	27	22.29 (13.36)
	WEST-ROC	*	*	ns	*	ns	ns	*	$t(6) = 2.85, p < .05$
	WEST-Trend	*	*	ns	*	*	*	*	$t(6) = 3.28, p < .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
PGC knowledge for nonword spelling (DiSTn; raw scores /46)	T1	7	13	7	1	18	3	16	9.29 (6.50)
	T2	3	4	1	2	16	1	16	6.15 (6.82)
	T3	31	34	6	11	28	6	21	19.57 (11.93)
	WEST-ROC	*	*	*	*	*	*	*	$t(6) = 3.27, p < .05$
	WEST-Trend	*	*	ns	*	*	ns	*	$t(6) = 2.95, p < .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Phoneme blending (CTOPP blending; raw scores / 18)	T1	8	7	12	6	9	3	7	7.43 (2.76)
	T2	8	9	11	7	9	3	9	8.00 (2.52)
	T3	9	8	11	7	11	7	10	9.00 (1.73)
	WEST-ROC	ns	ns	ns	ns	ns	ns	ns	$t(6) = 0.49, p > .05$
	WEST-Trend	ns	ns	ns	ns	ns	*	*	$t(6) = 0.99, p > .05$
	Trained (indirect)	✓	✓	✓	✓	✓	✓	✓	
Phoneme segmentation (CTOPP segmenting; raw scores/20)	T1	7	14	9	11	7	7	16	10.14 (3.67)
	T2	6	12	13	8	6	10	16	10.14 (3.76)
	T3	15	16	20	12	8	5	13	12.71 (5.02)
	WEST-ROC	*	ns	ns	*	ns	ns	ns	$t(6) = 1.10, p > .05$
	WEST-Trend	*	ns	*	ns	ns	ns	ns	$t(6) = 1.33, p > .05$
	Trained (indirect)	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Components of the lexical route. Table 9 shows the raw scores, weighted statistics, and training information related to the cognitive components in the lexical reading route. The raw scores and weighted statistics for the outcome measures for the individual components of the lexical route outcome measures are shown in Table 9. As a group, there were no significant improvements over the treatment period for any component of the lexical route. Individually, one child showed a significant improvement over the treatment period for the orthographic and semantics link (CL) and one child showed a significant overall

improvement for the orthographic and semantics link (CG). In terms of expressive vocabulary, single children showed significant improvements over the treatment period (RF) and significant improvements overall (CG).

In sum, all children received sight word or irregular word training that should have impacted the orthographic lexicon. No child received explicit training for the other components of the lexical route. At the group level, there was no significant treatment effect for any outcome measure. At the individual level, one child showed a significant improvement for the orthographic and semantics link (CL) and one child for the phonological lexicon (RF).

Table 9

Raw scores and WEST-ROC and WEST-TREND results for the components of the lexical route, with an indication of whether each component was trained during treatment

	Test	CL	ZK	YR	CG	RF	JA	FM	Group M (SD)
Orthographic lexicon (TOC; raw scores /30)	T1	20	20	12	19	18	21	13	17.57 (3.60)
	T2	19	14	12	16	15	16	13	15.00 (2.31)
	T3	17	15	11	18	14	14	15	14.86 (2.27)
	WEST-ROC	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 2.19, <i>p</i> < .05
	WEST-Trend	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = -2.41, <i>p</i> > .05
	Trained	✓	✓	✓	✓	✓	✓	✓	
Orthographic- semantics link (MeOWW; raw scores /40)	T1	29	24	21	22	29	29	24	25.29 (3.35)
	T2	24	27	19	27	28	32	26	26.14 (2.98)
	T3	28	24	22	30	28	31	25	25.43 (3.36)
	WEST-ROC	*	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = -0.53, <i>p</i> > .05
	WEST-Trend	ns	ns	ns	*	ns	ns	ns	<i>t</i> (6) = 0.09, <i>p</i> > .05
	Trained	X	X	X	X	X	X	X	
Phonological lexicon (ACE; raw scores / 25)	T1	18	13	12	13	20	8	12	13.71 (4.03)
	T2	20	12	10	13	17	10	11	13.29 (3.82)
	T3	17	12	12	17	21	9	13	14.43 (4.08)
	WEST-ROC	ns	ns	ns	ns	*	ns	ns	<i>t</i> (6) = 0.98, <i>p</i> > .05
	WEST-Trend	ns	ns	ns	*	ns	ns	ns	<i>t</i> (6) = 0.64, <i>p</i> > .05
	Trained	X	X	X	X	X	X	X	
Semantic knowledge (Squirrel Nut; raw score /57)	T1	56	52	57	52	51	46	54	52.57 (3.63)
	T2	57	57	56	55	51	50	51	53.86 (3.08)
	T3	57	54	57	54	52	51	55	54.29 (2.29)
	WEST-ROC	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = -0.47, <i>p</i> > .05
	WEST-Trend	ns	ns	ns	ns	ns	ns	ns	<i>t</i> (6) = 1.07, <i>p</i> > .05
	Trained	X	X	X	X	X	X	X	

Note. Significant effects (*p* < .05) are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Anxiety outcomes

Anxiety disorders. The remission rates are shown in Table 10. The raw scores on the outcome measures for anxiety disorders are shown in Tables 11 and 12. As a group, there was a significant reduction for social anxiety disorder and generalised anxiety disorder. For CL, the diagnoses for social anxiety disorder, generalised anxiety disorder, and all four specific phobias remitted (i.e., CSR below 4). For ZK, the diagnoses for social anxiety disorder and three out of four specific phobias remitted. She showed a reduction in the clinical severity for separation disorder. For YR, the diagnoses for generalised anxiety disorder and five out of seven specific phobias remitted. For CG, the diagnoses for social anxiety disorder, generalised anxiety disorder, and both specific phobias remitted. He continued to meet criteria for separation anxiety disorder. For RF, the diagnoses for social anxiety disorder, separation anxiety disorder, and specific phobia remitted. For JA, the diagnoses for social anxiety disorder remitted but not generalised anxiety disorder. For FM, the diagnoses for social anxiety disorder, generalised anxiety disorder, and specific phobias remitted.

In sum, all children received anxiety treatment for one or more problems with social anxiety, generalised anxiety, separation anxiety, and specific phobias. Overall, 57% of children did not meet diagnostic criteria for their primary diagnosis after the intervention, and 42% of children were identified as being remitted from all anxiety disorders. Individually, 79% of all diagnoses remitted after the intervention compared to 0% after the baseline period. As a group there was a significant reduction for social anxiety disorder and generalised anxiety disorder across intervention period but not the baseline period. Specifically, social anxiety disorder remitted for five children (83%), generalised anxiety remitted for four children (80%), separation anxiety remitted for one child (33%), and one or more specific phobias remitted for all children (85%).

Table 10

Diagnostic remission rates for all participants on the outcome measure for all anxiety disorders

Disorder	<i>n</i>	Free from diagnosis	%
All diagnoses	3 / 7		42%
Primary diagnoses	4 / 7		57%
Social anxiety disorder	5 / 6		83%
Generalised anxiety disorder	4 / 5		80%
Separation anxiety disorder	1 / 3		33%
Specific phobia ^a	17 / 20		85%
Total	27 / 34		79%

Note. Some participants had more than one diagnoses of specific phobia.

Table 11

Raw scores for anxiety disorders outcomes, with an indication of whether each outcome was trained during treatment

		CL	ZK	YR	CG	RF	JA	FM	Mean (SD)	Statistic
Social anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	6	6	ND	5	6	ND	5	4.67 (2.34) ^a	$F(2, 8) = 18.96, p < .01$
	T2	6	6	ND	5	6	4	5	5.33 (0.82) ^a	
	T3	4	0	ND	3	3	3	2	2.50 (1.38) ^b	
	Trained	✓	✓	X	✓	✓	✓	✓		
Generalised anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	5	ND	4	4	4	5	4	4.33 (0.52) ^a	$F(2, 8) = 5.16, p < .05$
	T2	5	ND	4	4	ND	4	4	3.50 (1.76) ^a	
	T3	3	ND	3	3	ND	5	2	2.67 (1.63) ^b	
	Trained	✓	X	✓	✓	X	✓	✓		
Separation anxiety disorder (ADIS-C/P; CSR raw scores / 8)	T1	ND	6	ND	4	5	ND	ND	5.00 (1.00)	$F(2, 4) = 2.00, p > .05$
	T2	ND	6	ND	5	5	ND	ND	5.33 (0.58)	
	T3	ND	4	ND	5	2	ND	ND	3.67 (1.53)	
	Trained	X	✓	X	✓	✓	X	X		

Note. Scores falling below the clinical threshold at T3 are bolded. Non-matching superscripts indicate significant differences. ND = not diagnosed. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. Grey cells indicate the primary diagnosis for each child.

Table 12

Raw scores for specific phobias outcomes, with an indication of whether each outcome was trained during treatment

	CL	ZK	YR	CG	RF	JA	FM
Specific phobias (ADIS-C/P; CSR raw scores / 8)	T1	Spiders: 4 Dark: 4 Clowns: 4 Doctor: 4	Wasps: 5 Loud noises: 5 Spiders: 4 Lifts: 4	Dogs: 4 Lifts: 4 Insects: 4 Dentist: 4 Dark: 4 Blood: 4 Spiders: 4	Heights: 4 Planes: 4	Dark: 4	n/d Spiders: 4 Heights: 4
	T2	Spiders: 4 Dark: 4 Clowns: 4 Doctor: 4	Wasps: 5 Loud noises: 5 Spiders: 4 Lifts: 4	Dogs: 4 Lifts: 4 Insects: 4 Dentist: 4 Dark: 4 Blood: 4 Spiders: 4	Heights: 4 Planes: 4	Dark: 4	n/a Spiders: 4 Heights: 4
	T3	Spiders: 0 Dark: 0 Clowns: 0 Doctor: 2	Wasps: 2 Loud noises: 0 Spiders: 4 Lifts: 2	Dogs: 3 Lifts: 0 Insects: 3 Dentist: 4 Dark: 0 Blood: 4 Spiders: 2	Heights: 0 Planes: 0	Dark: 3	n/a Spiders: 0 Heights: 0
	Trained	✓	✓	✓	✓	✓	X

Note. Scores falling below the clinical threshold at T3 are bolded. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

Anxiety symptoms. Raw scores, baseline-adjusted change scores, ANOVA statistics, and training information for the anxiety symptom outcome measures are shown in Table 13. As a group, parents reported a significant reduction in their child's total anxiety symptoms, social anxiety symptoms (SCAS and SPAI), generalised anxiety symptoms, separation anxiety symptoms, and panic/agoraphobia symptoms. At the individual level, CL showed significant reductions for social anxiety symptoms, separation anxiety symptoms, obsessive-compulsive symptoms, and total anxiety symptoms. ZK showed significant reductions for generalised anxiety symptoms, separation anxiety symptoms, and total anxiety symptoms. YR showed significant reductions for physical injury fears. CG showed significant reductions for social anxiety symptoms, generalised anxiety symptoms, panic/agoraphobia symptoms, and total anxiety symptoms. RF showed significant reductions for social anxiety symptoms, generalised anxiety symptoms, and total anxiety symptoms. JA showed significant reductions

for social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms, and total anxiety symptoms. FM showed no significant reductions for anxiety symptoms.

In sum, all children received anxiety treatment for one or more problems with social anxiety symptoms, generalised anxiety symptoms, and separation anxiety symptoms but not physical injury fears, panic/agoraphobia symptoms, or obsessive-compulsive symptoms. In line with this, as a group there were overall significant reductions for total anxiety symptoms, social anxiety symptoms (SCAS and SPAI), generalised anxiety symptoms, and separation anxiety symptoms over the treatment period. There was also a significant reduction for panic/agoraphobia symptoms. Individually, five children showed significant reductions for total anxiety symptoms (CL, ZK, CG, RF, JA), four children showed significant reductions for social anxiety symptoms (CL, CG, RF, JA) and generalised anxiety symptoms (ZK, CG, RF, JA), three children showed significant reductions for separation anxiety symptoms (CL, ZK, JA), and single showed reductions for children for physical injury fears (YR), obsessive-compulsive symptoms (CL), and panic/agoraphobia symptoms (CG).

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Table 13

Raw scores and repeated measures ANOVA statistics for parent-reported anxiety symptom outcomes, with an indication of whether each outcome was trained during treatment

		CL	ZK	YR	CG	RF	JA	FM	Mean (SD)
Social anxiety (SPAI-P; raw scores /52)	T1	38.90	21.73	12.00	30.21	25.3	24.92	15.60	24.09 (8.96)^a
	T2	37.56	16.26	11.00	32.6	21.43	24.68	21.25	23.68 (8.90)^a
	T3	24.11	6.06	2.33	23.8	6.25	19.66	16.83	14.14 (9.10)^b
	BAC (+/- 34.2)	-12.11	-4.73	-9.67	-11.19	-11.31	-4.78	-10.07	$F(2, 12) = 16.74, p < .001$
	Trained	✓	✓	X	✓	✓	✓	✓	
Social anxiety (SCAS-P; raw scores)	T1	16	11	5	11	7	7	8	9.28 (3.68)^a
	T2	17	7	2	13	10	13	9	10.14 (4.84)^a
	T3	8	4	1	5	4	4	3	5.00 (2.71)^b
	BAC (+/- 5.1)	-10	1	2	-10	-9	-15	-1	$F(2, 12) = 8.97, p < .01$
	Trained	✓	✓	X	✓	✓	✓	✓	
Generalised anxiety (SCAS; raw scores)	T1	7	5	7	11	6	5	3	6.28 (2.49)^a
	T2	7	11	6	13	8	8	2	7.85 (3.53)^a
	T3	5	3	3	7	4	2	3	3.85 (1.67)^b
	BAC (+/- 5.0)	-2	-14	-2	-8	-6	-9	2	$F(2, 12) = 9.89, p < .05$
	Trained	✓	X	✓	✓	X	✓	✓	
Separation anxiety (SCAS-P; raw scores)	T1	8	13	9	14	8	11	6	9.85 (2.91)^a
	T2	10	16	7	12	10	12	5	10.28 (3.59)^a
	T3	4	9	1	7	7	5	3	5.14 (2.73)^b
	BAC (+/- 5.6)	-8	-10	-4	-3	-5	-8	-1	$F(2, 12) = 24.43, p < .001$
	Trained	X	✓	X	✓	✓	X	X	
Physical injury fears (SCAS-P; raw scores)	T1	8	4	14	2	4	3	3	5.42 (4.23)
	T2	7	4	14	2	4	4	3	5.42 (4.07)
	T3	4	2	8	3	1	4	5	3.85 (2.26)
	BAC (+/- 4.4)	-2	-2	-6	1	-3	-1	2	$F(2, 12) = 2.04, p > .05$
	Trained	X	X	X	X	X	X	X	
Obsessive-compulsive (SCAS-P; raw scores)	T1	5	0	1	4	1	0	2	1.85 (1.95)
	T2	6	0	1	2	2	1	2	2.00 (1.91)
	T3	0	0	0	2	0	0	1	0.42 (0.78)
	BAC (+/- 4.1)	-7	0	-1	2	-3	-2	-1	$F(2, 12) = 3.78, p > .05$
	Trained	X	X	X	X	X	X	X	
Panic/agoraphobia (SCAS-P; raw scores)	T1	3	2	3	4	0	3	0	2.14 (1.57)^a
	T2	3	1	3	7	0	2	0	2.28 (2.42)^a
	T3	0	1	1	4	0	0	0	0.85 (1.46)^a
	BAC (+/- 4.4)	-3	1	-2	-6	0	-1	0	$F(2, 12) = 4.58, p < .05$
	Trained	X	X	X	X	X	X	X	
Total anxiety (SCAS-P; raw scores)	T1	47	35	39	46	26	29	22	34.85 (9.71)^a
	T2	50	39	33	49	34	40	21	38.00 (10.00)^a
	T3	21	19	14	28	16	15	21	19.14 (4.81)^b
	BAC (+/- 20.4)	-32	-24	-13	-24	-26	-36	1	$F(2, 12) = 22.58, p < .001$
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. Non-matching superscripts indicate significant differences. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. Grey cells indicate the symptom measure associated with the primary diagnosis for each child.

Anxiety interference. Raw scores, baseline-adjusted change scores, ANOVA statistics, and training information for the anxiety interference outcome measures are shown in Table 14. As a group, children showed significant reductions for anxiety interference at home, anxiety interference outside of home, and anxiety interference on parent life. Individually, CL's parent reported a significant reduction for anxiety interference at home and on parent life. ZK's parent reported a significant reduction for at home interference and outside home interference. YR's parent reported a significant reduction for at home interference and parent life interference. CG's parent reported a significant reduction for at home interference and parent life interference. RF's parent reported a significant reduction for at home interference only. JA's parent reported a significant reduction for at home interference and outside home interference. FM's parent reported no significant reductions for anxiety interference.

In sum, all children received anxiety treatment to lower anxiety interference at home, outside home, and interference on parent life. In line with this, there were significant reductions at the group level for at home, outside home, and parent life interference over the treatment period. Overall, six children showed significant reductions for at home interference (CL, ZK, YR, CG, RF, JA), two children showed significant reductions for outside home interference (ZK, JA), and three reported significant reductions for parent life interference (CL, YR, CG).

Table 14

Raw scores and repeated measures ANOVA statistics for parent-reported anxiety interference outcomes, with an indication of whether each outcome was trained during treatment

		CL	ZK	YR	CG	RF	JA	FM	Mean (SD)
Home interference (CALIS-P /raw scores)	T1	12	9	8	9	3	11	10	8.85 (2.91)^a
	T2	12	8	8	8	5	9	10	8.57 (2.14)^a
	T3	8	3	3	4	2	3	9	4.57 (2.76)^b
	BAC (+/- 2.9)	-4	-4	-5	-3	-5	-4	-1	$F(2, 12) = 22.31, p < .001$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Outside home interference (CALIS-P /raw scores)	T1	16	12	3	7	10	10	14	10.28 (4.34)^a
	T2	15	10	3	6	8	12	9	9.00 (3.91)^a
	T3	11	1	1	5	2	4	8	4.57 (3.77)^b
	BAC (+/- 4.7)	-3	-7	-2	0	-4	-10	4	$F(2, 12) = 14.65, p < .01$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Parent life interference (CALIS-P /raw scores)	T1	13	17	11	5	2	8	8	9.14 (5.01)^a
	T2	13	6	11	10	3	8	7	8.28 (3.35)^a
	T3	5	0	3	3	0	4	3	2.57 (1.90)^b
	BAC (+/- 6.8)	-8	5	-8	-12	-4	-4	-3	$F(2, 12) = 9.68, p < .01$
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. Non-matching superscripts indicate significant differences. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

DISCUSSION

The aims of the current interventional case series were to measure the effects of a revised version of Cool Reading on reading outcomes (Aim 1) and anxiety outcomes (Aim 2) in children with concomitant poor reading and anxiety. From our previous interventional pilot case series (see Chapter 5), we predicted that Cool Reading would significantly improve regular word reading accuracy, reading comprehension, nonword reading accuracy and fluency and spelling, and GPC knowledge. Due to mixed findings in the pilot study, it was unclear if Cool Reading would significantly improve the lexical reading route. In terms of anxiety, we predicted that there would be significant reductions for anxiety disorders, anxiety symptoms, and anxiety interference. Below, we discuss the results for each aim in turn. We then turn to the clinical implications, limitations, and directions for future research stemming from this study.

Aim 1: The effect of cool reading on reading outcomes

In terms of general reading skills, we found that Cool Reading had a significant treatment effect at the group level, and in three of the seven individual children, for regular word reading accuracy. This was not the case for reading fluency or reading comprehension at the group level, and only one of seven children showed significant treatment effects at the individual level. These outcomes align with the reading treatments that were administered to children, which focused on word reading accuracy but not reading fluency or reading comprehension. Thus, for general reading skills, children improved in skills that were directly trained (i.e., regular word reading accuracy) with no generalisation to reading skills that were not trained (i.e., reading fluency and reading comprehension).

In terms of the nonlexical reading route, Cool Reading had a significant treatment effect at the group level, and for two to four children, for nonword spelling accuracy and nonword reading accuracy. There was no significant treatment effect at the group level for nonword reading fluency, and only two children showed significant treatment effects at the individual level. This again aligns with the reading treatment components administered to the children, who were trained for nonword reading accuracy and spelling but not nonword reading fluency. Thus, children improved in nonlexical reading skills that were directly trained with little or no generalisation to nonlexical skills that were not directly trained.

The lexical reading route outcomes were more complex. Cool Reading had a significant treatment effect at the group level for trained spelling sight words (seven children) or spelling irregular words (four children), but not for trained reading sight words or irregular words – despite the fact that children were trained to both spell and read sight words and irregular words. A similar pattern of results was observed in the pilot study in Chapter 5. There are two potential explanations for the mismatch between the spelling and reading outcomes. First, the irregular word spelling test included trained words but the irregular word

reading test did not. Hence, the irregular word spelling test should have been more sensitive to specific treatment effects than the irregular word reading test. Second, the sight word reading test showed larger test-retest effects from T1 to T2 than the sight word spelling test, and these test-retest gains were similar in size to those observed from T2 to T3. For reasons we cannot explain, this suggests that the sight word reading test was prone to large test-retest effects that may have obscured any treatment effects that may have been present between T2 and T3. Considered together, these findings suggest that Cool Reading does improve the lexical reading route, but that this effect is only apparent in spelling outcomes that included trained items and hence were sensitive to very specific treatment effects.

In terms of the cognitive components common to both lexical and nonlexical reading routes, Cool Reading did not have a treatment effect at the group level for letter identification, letter position encoding, or phonological output. The lack of effects for letter position encoding and phonological output are perhaps not surprising given that children received indirect training for these skills. In contrast, six of the seven children received direct training for letter identification. However, their performance was close to ceiling before treatment, and hence room for improvement due to training was restricted. These findings support those outlined above and suggest that Cool Reading has a significant treatment effect on reading skills that are directly trained, but limited or no effect on reading skills that are indirectly trained, or are assessed with measures that are less sensitive to trained skills.

Moving to the components of the nonlexical route, Cool Reading had a significant treatment effect at the group level, and in four to seven children, for GPC knowledge for individual graphemes, GPC knowledge for nonword reading, and PGC knowledge for nonword spelling but not for phoneme segmentation (no group or individual effects) or phoneme blending (only an individual effect for two of seven children). This pattern of outcomes yet again reflects the types of training administered to each child, with direct

training for reading and spelling GPCs within the context of words and nonwords, but indirect training for blending and segmenting via corrective feedback.

In terms of the cognitive components of the lexical reading route, Cool Reading did not have a treatment effect at the group level for the orthographic lexicon, orthographic-semantics link, the phonological lexicon, or semantic knowledge. In the pilot study, we also tested the orthographic lexicon and orthographic-semantics link before and after Cool Reading, and we also found little change in the raw scores. The lack of change in these scores across the studies may have occurred because the tests did not include trained items and hence were less sensitive to specific treatment effects.

In sum, the results suggest that Cool Reading had a significant and positive treatment effect on one general reading skill (regular reading accuracy), the nonlexical route (nonword reading accuracy, nonword spelling), on one cognitive component of the nonlexical route (GPC knowledge), and on the lexical route (irregular spelling, sight word spelling). These outcomes were almost identical to the pilot study except for one general reading skill (reading comprehension) which significantly improved for three of four children in the interventional pilot case series (see Chapter 5). Considered together, the findings of both studies suggest that the reading treatments in Cool Reading have significant treatment effects on reading skills that are both trained directly and measured explicitly. There was limited generalisation to reading skills or cognitive components that were not directly trained (e.g., reading fluency, reading comprehension, phonological output, letter position encoding) or were not assessed with measures that included explicitly trained items or skills. We predict that the explicit and direct training and measurement of these reading skills or cognitive components would result in observable treatment effects.

Aim 2: The effect of cool reading on anxiety outcomes

The second aim of this study was to evaluate the effect of a revised version of Cool Reading on anxiety outcomes. The results showed that 57% of children did not meet diagnostic criteria for their primary anxiety disorder after the intervention, and 42% of children were remitted for all anxiety disorders. Across all anxiety disorders, 79% of anxiety disorders were remitted for all children, and there were specific and significant reductions for generalised anxiety disorder and social anxiety disorder. These remission rates are much improved from the 0% remission rate reported in the pilot study (see Chapter 5) and are also more consistent with the 68% primary anxiety disorder remission rate for the Cool Kids programme (Hudson, Rapee, Deveney, Schniering, Lyneham, & Bovopoulos, 2009). The results also showed significant reductions in anxiety symptoms (social anxiety, generalised anxiety, separation anxiety, panic/agoraphobia), and anxiety interference (home, outside of home, parent life) specifically over the treatment period. Considered together, Cool Reading had a positive and significant effect to reduce anxiety disorders, anxiety symptoms, and anxiety interference in children.

What might account for the improved anxiety outcomes in the current interventional case series compared to the pilot study? One explanation may be the integration of the specific social anxiety treatment components into Cool Reading. Six of the seven children in this study were diagnosed with social anxiety disorder and hence completed gradual exposure tasks that integrated attention training, safety behaviours experiments, and video feedback experiments into their treatment program. Children reported that the video feedback experiments were especially confronting, but also very useful to modify the beliefs about their reading ability. Hence, integrating these social anxiety specific treatment components into Cool Reading may have improved anxiety outcomes in the current study.

A second explanation may be that children benefited greatly from the introduction of gradual exposures earlier in the revised version of Cool Reading. This allowed children to complete more in-session exposures, and also develop coping skills to face challenging reading-related gradual exposures. The additional in-session exposures also enabled the clinician to provide more feedback to children about their gradual exposure attempts. Thus, increasing the quantity, intensity, and specificity of in-session Gradual Exposures in the revised version of Cool Reading may have contributed to the improved anxiety outcomes for children in this study.

It is also possible that the clinician administering the treatment was more experienced in helping children with concomitant poor reading and anxiety (Note. The first author DF administered the treatment in the pilot study and the current study). We are unaware of any clinician who treats poor reading and anxiety simultaneously within sessions. Treating these concomitant problems presents numerous challenges to a clinician. One challenge pertains to encouraging children with anxiety to read aloud and receive negative feedback (i.e., corrective feedback) repeatedly within a session, three times per week, for 12 weeks. Reading aloud, writing, and asking for help were significant sources of anxiety for six of the seven children. In the current study, the clinician found it useful to build rapport with children and provide them with numerous opportunities for success each session. In addition, it was important to boost the child's confidence reading aloud (i.e., select books of interest for the child that did not exceed their skill level) as well as normalise the experience of poor reading and anxiety. Thus, it is possible that greater experience working with this child population contributed to improved anxiety outcomes in this study.

It is noteworthy that all parents in this study were very engaged and motivated throughout the treatment period, more so than the parents in the pilot study (Chapter 5). Importantly, parents completed numerous gradual exposures with children outside the

treatment sessions. This additional practice and reinforcement from parents may have contributed to improved outcomes. That said, the clinician also noted that parents often still had not read the parent manual, and often contacted the clinician outside of session times to discuss content and difficulties occurring at home. Hence, it may be worthwhile for future versions of Cool Reading to simplify the parent material and increase the allocated time per session for a discussion between the clinician and parent about the child's progress at home.

In sum, the results suggest that Cool Reading had a significant and positive effect on remission rates for anxiety disorders (social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, specific phobias), and significantly reduced anxiety symptoms (social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms), and anxiety interference (home interference, outside home interference, parent life interference). These effects were markedly better than those observed in the previous pilot study. There are a number of potential reasons for these improved effects, which provide insights into how Cool Reading might be improved in future versions.

Clinical implications

Before this investigation, it was not known if it was possible to effectively treat concomitant problems in reading and anxiety in children, or if this could be done through integrated reading and anxiety treatment. The outcomes of the interventional case series firmly suggest that integrated reading and anxiety treatment is effective for children with concomitant reading and anxiety problems. We can therefore recommend that clinicians (i.e., reading specialists, psychologists, speech pathologist, special education teachers, school counsellors) administer integrated reading and anxiety treatment to children with these difficulties. We can also recommend the use of Cool Reading to deliver this treatment since, according to the National Health and Medical Research Council Evidence Hierarchy (NHMRC, 2000; Australian Government handbook to guide the development of evidence

based clinical interventions), our interventional case series provided Level IV evidence (i.e., case series studies with either post-test or pre-test/post-test outcomes) that Cool Reading is effective for improving reading and anxiety outcomes in children. However, consistent with these guidelines and best scientific and clinical practice, Cool Reading must also be subjected to a rigorous randomised controlled trial (RCT) to boost the quality of the supporting evidence further. This is the goal of the next step in our research programme.

If a clinician does not feel comfortable administering a treatment supported by Level IV evidence (in this case, Cool Reading), they may wish to create their own integrated treatment by combining RCT-supported reading and anxiety interventions. Below, we provide five recommendations to help clinicians develop and administer such a treatment. The first recommendation is that clinicians *must* select evidence-based treatments for both reading and anxiety. These selected treatments should focus training explicitly and directly on the specific types of problems that a child has with reading and anxiety. In terms of reading, this approach depends critically upon detailed evidence-based assessment for irregular and nonword reading accuracy, irregular and nonword reading fluency, and reading comprehension. In terms of anxiety, it depends upon evidence-based assessment for the child's primary and additional anxiety disorders including social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, specific phobias, panic disorder, and obsessive-compulsive disorder. The outcomes of these assessments will reveal what types of reading and anxiety are impaired in a child, and hence the treatments that are required. Chapter 4 outlines a selection of evidence-based assessments and treatments for each of these types of reading and anxiety problems. Clinicians can select these clinical tools to target the specific reading and anxiety problems of a child, or they may an alternative evidence-based reading and anxiety treatments to target a child's specific reading and anxiety problems.

Once clinicians have selected their evidence-based reading and anxiety treatments, we recommend that reading and anxiety training is integrated within and across sessions in the following way. In the first session, the child and their parent are given an introduction to the program, the rationale for treatment (i.e., improve reading and lower anxiety), an overview of the skills that they will learn, and commence goal setting and psychoeducation about anxiety. In the second session, the child is introduced to the first two anxiety treatment components that will be used throughout the program. This usually includes cognitive restructuring and a relaxation technique that aims to reduce arousal (e.g., controlled breathing). In the third session, the child is instructed to use the relaxation technique to reduce their arousal (5 minutes), and then the child completes the first component of reading treatment (40 minutes). This is followed by cognitive restructuring practice with both the child and the parent (10 minutes), and then a short interview ("check-in") with the parent about the child's progress at home (5 minutes or more). This session structure (i.e., reduce arousal - reading training – cognitive restructuring – checking in) is repeated across sessions until the child has developed skills in cognitive restructuring. At this point, clinicians can introduce gradual exposures alongside cognitive restructuring (e.g., 10 minutes of the session dedicated to gradual exposures and 5 minutes of the session dedicated to cognitive restructuring). This new session structure - comprising reduced arousal, reading training, gradual exposures and cognitive restructuring, checking in - is continued in each session until the child has mastered their reading and anxiety treatment programs or the dedicated treatment period has been completed.

Gradual exposure tasks are important components of the sessions outlined above. We recommend that gradual exposure tasks focus on both social anxiety and reading-related anxiety. The reading-related exposures can be integrated into the social anxiety treatment components using a number of tasks. Attention training can be used to teach children to focus

on reading while the clinician introduces distractions such as people whispering and laughing. Video feedback can be used to record the child's gradual exposure practice when the child is reading aloud. While watching the recording, the clinician and child can discuss evidence about the reading practice which allows the child to develop an accurate and realistic perception of their ability. Gradual exposure tasks with safety behaviours can be used to teach children how read without a safety behaviour (e.g., reading aloud while standing tall vs reading aloud with head bowed down).

Our final recommendation relates to the modification of existing anxiety treatments so they that are accessible to children with reading difficulties. This is important because most child anxiety treatments include a manualised (i.e., written) workbook that requires the child to read and write to complete the intervention (Barrett & Turner, 2001; Hirshfeld et al., 2008; Lyneham et al., 2003; Kendall et al., 1990). If a clinician has a manualised anxiety treatment that they commonly administer, then they should modify the written materials of this treatment to suit poor readers. For example, to reduce the writing demands on the child, clinicians can ask parents to write their child's responses, or encourage children to draw pictures. To minimise reading demands, clinicians can introduce written activities through a discussion between the clinician, child, and parent. Clinicians can also modify activity sheets to use pictures or visual cues (i.e., mnemonics) to teach children strategies. These modifications will help children access and engage with the anxiety treatment more readily.

Limitations and future directions

As always, the outcomes of this research must be considered within the context of its strengths and limitations. The first limitation to be considered is that children provided their own control data, which is a standard approach in interventional case series studies (e.g., Brunsdon, Coltheart, & Nickels, 2005; Shallice & Evans, 1998). The use of a double baseline period means that children are tested twice (T1 and T2) before they receive the intervention.

Any gains made in the outcome measures over this period are used to represent the influence of non-treatment effects on outcome scores, such as test-retest or maturation effects. This approach relies on the assumption that these non-treatment effects remain the same across the treatment period (i.e., from T2 to T3). However, this assumption may not be correct. There is evidence that test-retest effects on reading measures reduce across assessment sessions (Bartels, Wegrzyn, Wiedl, Ackerman, & Ehrenreich, 2010; Collie, Maruff, Darby, & McStephen, 2003; Kohnen, Nickels, & Coltheart, 2010). Thus, within-subject double baseline effects occurring from T1 to T2 may overestimate non-treatment effects occurring from T2 to T3, which would underestimate the size of treatment effects. To address this limitation, more complex controlled case design such as an ABABAB or multiple baseline design would provide insight to outcomes directly associated with the treatment. Following this, a separate group of untrained controls who are tested across the treatment period for comparison with children who received treatment could be recruited. This approach is often used in randomised controlled trials. Hence, while an interventional case series design was the most appropriate choice for the current study, we aim to overcome this limitation in future studies by trialing our new version of Cool Reading in a randomised controlled trial with an untreated waitlist control group.,

A second limitation of this study is that we assessed children for their reading and anxiety once they completed Cool Reading. This immediate post-test demonstrates the immediate effect of Cool Reading on reading and anxiety outcomes. However, it does not shed light on whether the treatment gains are maintained over time. Hence, future research should consider administering short term (e.g., 3 months) and long term (e.g., 12 months) post-test assessments to evaluate whether the improvement in anxiety is maintained over time. Future trials of Cool Reading may also consider regular long-term follow-up assessments throughout childhood and adolescents to evaluate the maintenance of

improvements over longer periods. Thus, additional post-test assessments will provide insight to the ongoing benefits of Cool Reading.

A third potential limitation to be considered is the statistical analysis of our reading outcomes. In this study, we used rigorous and conservative weighted statistics to analyse significant change over the treatment period for individual children (Howard et al., 2015). This approach assumes that all items of all tests are administered. However, many standardised clinical tools used to assess reading do not administer all test items. Rather, these tests appropriately include discontinue rules for the practical and ethical reasons described above. We retained the discontinue rule for tests that used them and made the critical assumption that all children would have failed all items that fell beyond the discontinue point. This assumption allowed us to protect the wellbeing of the child. Nevertheless, we acknowledge that this assumption may overestimate treatment effects for these specific tests at the individual level. To overcome this limitation, future research should evaluate reading outcomes at the group level in a large randomised controlled trial of poor readers with anxiety.

A very clear learning point from the current study was the degree to which reading treatment effects were specific to the reading skills that were trained. The specificity of this treatment is consistent with outcomes from previous interventional case series and randomised controlled trials that show reading treatment has a direct effect on trained but not untrained items (Brunsdon et al., 2005; Lovett, Warren-Chaplin, Ransby, & Borden, 1990; McArthur et al., 2015a; 2015b; Kohnen, Nickels, Coltheart, & Brunsdon, 2010). However, it does not align with many reading intervention studies that use standardised and normed assessments to index reading treatment effects, which are not designed to assess directly-trained skills or knowledge. Hence, a limitation of the current study is that we did not administer trained and untrained sets of items for all reading outcome measures, which are

required to estimate direct treatment effects (trained items) and indirect treatment effects (untrained items). This suggests that we may have underestimated some treatment effects by expecting generalisation of direct skills to untrained items (i.e., lexical route and cognitive components of the lexical route). Thus, future research should include trained and untrained items of all reading outcomes to test direct and indirect reading treatment effects.

A final limitation of this study to consider is the multiple comparisons performed in the analyses. We acknowledged the issue of multiple comparisons in the profiling study (Chapter 3), and hence aimed to ascertain the reliability of those findings in the current study. In terms of reading, the outcomes of the pilot study and the current study are very consistent. In terms of anxiety, the outcomes and improvements are much improved and in line with previous research on Cool Kids. Hence, we can be more confident that the reliability of these findings was not simply due to Type I errors. Combined with our insights about the importance of specifically testing the effects of what has been specifically trained, we can recommend that future studies limit the chance of Type 1 errors by focusing assessment on the specific reading and anxiety skills that are targeted by any version of integrated reading and anxiety treatment.

Summary

To summarise, this study aimed to evaluate the efficacy of our revised version of Cool Reading with seven children with poor reading and anxiety. Overall, we found that Cool Reading significantly improved general reading skills (reading accuracy), the nonlexical route and individual components of the nonlexical route (nonword reading accuracy, nonword spelling, GPC knowledge), and the lexical route (irregular spelling, sight word spelling). We also found that Cool Reading significantly reduced anxiety disorders (primary anxiety diagnoses for social anxiety, generalised anxiety, separation anxiety, specific phobias), anxiety symptoms (social anxiety, generalised anxiety, separation anxiety), and

anxiety interference (at home, outside of home, and parent life). Considered together, Cool Reading is an effective integrated treatment for children with concomitant poor reading and anxiety.

REFERENCES

- Adams, C., Coke, R., Crutchley, A., Hesketh, A., & Reeves, D. (2001). *Assessment of comprehension and expression 6–11*. London: NFER-Nelson.
- Bartels, C., Wegrzyn, M., Wiedl, A., Ackermann, V., Ehrenreich, H. (2010). Practice effects in healthy adults: a longitudinal study on frequent repetitive cognitive testing. *BMC Neuroscience*, 11, 118–130. doi: 10.1186/1471-2202-11-118
- Beidel, D. C., Turner, S. M., Hamlin, K., & Morris, T. L. (2000). The Social Phobia Anxiety Inventory for Children (SPAI-C): External and discriminative validity. *Behavior Therapy*, 31, 75–87. doi: 10.1016/S0005-7894(00)80005-2
- Brunsdon, R., Coltheart, M., & Nickels, L. (2005). Treatment of irregular word spelling in developmental surface dysgraphia. *Cognitive Neuropsychology*, 22, 213-251. doi: 10.1080/02643290442000077
- Castles, A., & Coltheart, M. (1996). Cognitive correlates of developmental surface dyslexia: A single case study. *Cognitive Neuropsychology*, 13, 25–50. doi: 10.1080/026432996382051
- Cates, G. L., Burns, M. K., & Joseph, L. M. (2010). Introduction to the special issue: Instructional efficiency and the impact on learning and data-based decision making. *Psychology in the Schools*, 47, 111–113. doi: 10.1002/pits.20456
- Chapman, J. W., & Tunmer, W. E. (1995). Development of young children's reading self-concepts: An examination of emerging subcomponents and their relationship with reading achievement. *Journal of Educational Psychology*, 87, 154-167. doi: 10.1037/0022-0663.87.1.154
- Colenbrander, D., Kohnen, S., & Nickels, L. (2011). Diagnostic reading test for nonwords (DiRT). Retrieved from <http://www.motif.org.au>

- Collie, A., Maruff, P., Darby, D., & McStephen, M. (2003). The effects of practice on the cognitive test performance of neurologically normal individuals assessed at brief test–retest intervals. *Journal of the International Neuropsychological Society*, 9, 419–428. doi: 10.1017/S1355617703930074.
- Conners, K. C. (2008). *Conners 3 (3rd ed.)*. New York: Multi-Health Systems Inc.
- Dodd, B., Holm, A., Oerlemans, M., & McCormick, M. (1996). *Queensland Inventory of Literacy (QUIL)*. Brisbane, Australia: University of Queensland.
- Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38, 581-586. doi: 10.1111/j.1469-7610.1997.tb01545.x
- Grills, A.E. , & Ollendick, T.H. (2003). Multiple informant agreement and the anxiety disorders interview schedule for parents and children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 42, 30-40. doi: 10.1097/00004583-200301000-00008
- Howard, D., Best, W., & Nickels, L. (2015). Optimising the design of intervention studies: Critiques and ways forward. *Aphasiology*, 29, 526-562. doi: 10.1080/02687038.2014.985884
- Hudson J. L., Rapee, R.M., Deveney, C., Schniering, C.A., Lyneham, H., & Bovopoulos, N. (2009). Cognitive-behavioral treatment versus an active control for children and adolescents with anxiety disorders: A randomized trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 46, 533-544. doi: 10.1097/CHI.0b013e31819c2401
- Joseph, L. M., & Nist, L. M. (2006). Comparing the effects of unknown-known ratios on word reading learning versus learning rates. *Journal of Behavioral Education*, 15, 69–79. doi: 10.1007/s10864-006-9008-8

- Joseph, L. M., & Schisler, R. A. (2007). Getting the “most bang for your buck”: Comparison of the effectiveness and efficiency of phonic and whole word reading techniques during repeated reading lessons. *Journal of Applied School Psychology, 24*, 69–90. doi: 10.1300/J370v24n01_04
- Kaufman, A., & Kaufman, N. (2004). *Manual for the Kaufman Brief Intelligence Test*. Circle Pines, MN: American Guidance Service.
- Kohnen, S., Anandakumar, T., McArthur, G. & Castles, A. (2012). *The Test of Orthographic Choice (TOC)*. Available from www.motif.org.au
- Kohnen, S. & Banales, E. (2015a). *The Macquarie University Reading Clinic Reading Gap intervention program*. Sydney: Macquarie University.
- Kohnen, S. & Banales, E. (2015b). *The Macquarie University Reading Clinic Spelling Gap intervention program*. Sydney: Macquarie University.
- Kohnen, S. & Banales, E. (2015c). *The Macquarie University Reading Clinic Sight words intervention program*. Sydney: Macquarie University.
- Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.
- Kohnen, S., Colenbrander, D., & Nickels, L. (2012). *Diagnostic spelling test – irregular words with normative data*. Available from www.motif.org.au.
- Kohnen, S., Larsen, L., Jones, K., Castles, A., & McArthur, G. (2012). *The Meanings of Written Words Test (MeOWW)*. Available from www.motif.org.au.
- Kohnen, S., Nickels, L., & Castles, A. (2009). Diagnostic spelling test – Spelling nonwords to dictation. Retrieved from <http://www.motif.org.au>
- Kohnen, S., Nickels, L., & Coltheart, M. (2010). Skill generalisation in teaching spelling to children with learning difficulties. *Australian Journal of Learning Difficulties, 15*, 115–129. doi: 10.1080/19404158.2010.502588.

- Kohnen, S., Marinus, E., Friedmann, N., Anandakumar, T., Nickels, L., McArthur, G., & Castles, A. (2012). *Letter Position Test*. Available from www.motif.org.au.
- Larsen, L., Kohnen, S., Nickels, L., & McArthur, G. (2015). The letter-sound test (LeST): A reliable and valid comprehensive measure of grapheme-phoneme knowledge. *Australian Journal of Learning Difficulties*, 20, 129-142. doi: 10.1080/19404158.2015.1037323
- Lovett, M. W., Warren-Chaplin, P. M., Ransby, M. J., & Borden, S. L. (1990). Training the word recognition skills of reading disabled children: Treatment and transfer effects. *Journal of Educational Psychology*, 82(4), 769-780. doi: 10.1037/0022-0663.82.4.769
- Lyneham, H. J., Sburlati, E. S., Abbott, M. J., Rapee, R. M., Hudson, J. L., Tolin, D. F., & Carlson, S. E. (2013). Psychometric properties of the child life interference scale (CALIS). *Journal of Anxiety Disorders*, 27, 711-719. doi: 10.1016/j.janxdis.2013.09.008
- McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015a). Sight word and phonics training in children with dyslexia. *Journal of Learning Disabilities*, 48, 391-407. doi: 10.1177/0022219413504996
- McArthur, G., Kohnen, S., Jones, K., Eve, P., Banales, E., Larsen, L., & Castles, A. (2015b). Replicability of sight word training and phonics training in poor readers: A randomised controlled trial. *PeerJ* 3:e922. doi: 10.7717/peerj.922
- Neale, M. (1999). *Neale analysis of reading ability* (3rd ed.). Melbourne: Australian Council for Educational Research.
- Rapee, R. M., Barrett, P. M., Dadds, M. R., & Evans, L. (1994). Reliability of the DSM-III-R childhood anxiety disorders using structured interview: Interrater and parent-child

- aggreemnt. *Journal of the American Academy of Child and Adolescent Psychiatry*, 33, 984-992. doi: 10.1097/00004583-199409000-00008
- Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. *Clinical Psychology Review*, 20, 453-478. doi: 10.1016/S0272-7358(99)00037-9
- Semel, E., Wiig, E., & Secord, W. (2006). *Clinical evaluation of language fundamentals (4th ed., Australian standardised edition (CELF-4 Australian))*. Sydney, Australia: Pearson Inc.
- Shallice, T., & Evans, M. E. (1978). The involvement of the frontal lobes in cognitive estimation. *Cortex*, 14, 294-303. doi: 10.1016/S0010-9452(78)80055-0
- Silverman WK, Albano AM (1996), *The Anxiety Disorders Interview Schedule for Children for DSM-IV: Child and Parent Versions*. San Antonia, TX: Psychological Corporation.
- Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour Research and Therapy*, 36, 545-566. doi: 10.1016/S0005-7967(98)00034-5
- Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). *Test of word reading efficiency (TOWRE)*. Austin, TX: ProEd.
- Wagner R., Torgesen J., & Rashotte C. (1999). *Comprehensive test of phonological processing. Examiner's Manual*. San Antonio, TX: Pearson Assessments.
- Wheldall, K., & Madelaine, A. (2013). *The Wheldall assessment of reading passages (WARP) manual*. Sydney: MultiLit Pty.

APPENDIX A

Anxiety outcomes using the child report questionnaire data

Table A1

Raw scores and repeated measures ANOVA statistics for child-reported anxiety symptom outcomes, with an indication of whether each outcome was trained during treatment

		CL	ZK	YR	CG	RF	JA	FM	Mean (SD)
Social anxiety (SPAI-C; raw scores /52)	T1	17.83	17.4	1.00	31.96	37.82	8.00	7.58	17.37 (13.43)
	T2	29.70	6.06	4.40	26.5	36.48	15.00	5.00	17.59 (9.72)
	T3	14.66	3.60	0.00	29.5	12.38	17.33	8.66	12.30 (9.72)
	BAC +/- 3.5	-9.10	-8.13	-2.7	0.27	-24.77	5.83	2.37	$F(2, 12) = 1.41, p > .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Social anxiety (SCAS-C; raw scores)	T1	9	4	3	4	10	1	1	4.57 (3.59)
	T2	7	5	5	8	3	0	0	4.00 (3.16)
	T3	3	1	2	6	1	1	2	2.28 (1.79)
	BAC +/- 4.1	-5	-3.5	-2	0	-5.5	0.5	1.5	$F(2, 12) = 1.76, p > .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Generalised anxiety (SCAS-C; raw scores)	T1	10	1	5	10	12	5	2	6.42 (4.27)
	T2	7	1	6	9	8	1	1	4.28 (3.30)
	T3	3	2	5	7	5	0	0	3.14 (2.67)
	BAC +/- 3.6	-5.5	1	-0.5	-2.5	-3.5	-3	-1.5	$F(2, 12) = 5.78, p < .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Separation anxiety (SCAS-C; raw scores)	T1	14	8	5	6	15	2	2	7.42 (5.28)
	T2	6	8	5	9	10	2	2	5.71 (2.87)
	T3	2	4	2	7	7	0	3	3.57 (2.63)
	BAC +/- 3.0	-8	-4	-3	-0.5	-4.5	-2	1	$F(2, 12) = 3.68, p > .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Physical injury fears (SCAS-C; raw scores)	T1	6	5	6	5	3	1	2	4.00 (2.00)
	T2	5	3	5	5	4	0	1	3.28 (2.05)
	T3	3	5	4	2	2	0	2	2.57 (1.61)
	BAC +/- 3.0	-2.5	1	-1.5	-3	-1.5	-0.5	0.5	$F(2, 12) = 3.72, p > .05$
	Trained	✓	✓	✓	✓	X	✓	✓	
Obsessive-compulsive (SCAS-C; raw scores)	T1	11	6	4	12	11	7	6	8.14 (3.13)^a
	T2	10	4	6	13	2	8	4	7.42 (3.25)^a
	T3	4	0	1	9	2	0	2	2.71 (3.04)^b
	BAC +/- 4.0	-6.5	-4	-4	-3.5	-7	-7.5	-3	$F(2, 12) = 26.55, p < .001$
	Trained	X	X	X	X	X	X	X	
Panic / agoraphobia (SCAS-C; raw scores)	T1	9	5	5	8	12	2	0	5.85 (4.14)^a
	T2	2	1	5	10	0	0	0	2.71 (4.02)^a
	T3	2	0	1	4	5	0	0	1.71 (2.05)^b
	BAC +/- 4.8	-3.5	-3	-4	-5	-5	-1	0	$F(2, 12) = 8.34, p < .01$
	Trained	X	X	X	X	X	X	X	
Total anxiety (SCAS-C; raw scores)	T1	59	29	28	45	63	18	13	36.43 (19.59)^a
	T2	37	22	32	54	34	11	8	28.43 (16.05)^a
	T3	17	13	1	35	22	1	9	16.00 (10.66)^b
	BAC +/- 16.7	-31	-12.5	-15	-14.5	-27	-13.5	-1.5	$F(2, 12) = 9.84, p < .01$
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. Non-matching superscripts indicate significant differences. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure. Grey cells indicate the symptom measure associated with the primary diagnosis for each child.

Table A2

Raw scores and repeated measures ANOVA statistics for child-reported anxiety interference outcomes, with an indication of whether each outcome was trained during treatment

		CL	ZK	YR	CG	RF	JA	FM	Mean (SD)
Home interference (CALIS-C /raw scores)	T1	11	1	7	12	11	3	6	7.28 (4.27)^a
	T2	10	4	5	5	9	2	3	5.42 (2.99)^a
	T3	1	2	1	5	3	2	1	2.14 (1.46)^b
	BAC +/- 1.6	-9.5	-0.5	-5	-3.5	-7	-0.5	- 3.5	$F(2, 12) = 8.17, p < .01$
	Trained	✓	✓	✓	✓	✓	✓	✓	
Outside home interference (CALIS-C /raw scores)	T1	1	0	0	6	12	11	1	4.42 (5.25)
	T2	4	2	0	6	10	0	0	3.14 (3.80)
	T3	0	1	1	2	3	0	4	1.42 (1.61)
	BAC +/- 1.0	-2.5	0	0	-4	-8	-5.5	3.5	$F(2, 12) = 1.54, p > .05$
	Trained	✓	✓	✓	✓	✓	✓	✓	

Note. Significant effects ($p < .05$) are bolded. Non-matching superscripts indicate significant differences. ✓ and X indicate that a child was or was not (respectively) trained in skills that are indexed by that outcome measure.

APPENDIX B

Mathematical equations to calculate the baseline adjusted change scores

Individual Case Studies, double-baselines

Serje Robidoux

09/05/2019

The problem

For each child, we have measurements on a particular test at three timepoints. This is a clinical intervention, so there are two baseline measures at Time 0 and Time 8 wks (T1 and T2, respectively), then a third measurement after a further 8 weeks of intervention (so T3 is 16 wks). The test used is a normed test with known¹ standard deviation and test-retest reliabilities.

The logic of this design is that children's scores will change with time, simply due to cognitive maturation. By measuring the amount of change from T1 to T2, we can get an index of how much this happens. Then that change can be removed from the change between T3 and T2, and the leftover bit can be attributed to the intervention.

The questions

Howard et al. (2014) describe two ways of thinking about these test scores. In both cases, the question we are asking is essentially the same: is the score at T3 larger than we expect based on the scores at T2 and T1? The difference is in what counts as "larger", and that depends on what we think the measures at T1 and T2 represent.

The simpler scenario (COL, or COmpare Level according to Howard et al.) is relevant when there is no particular reason to think that T1 and T2 differ in any way, so that T1 and T2 are really just two measurements of the exact same thing. Any change from T1 to T2 is just due to the (un)reliability of the testing, and not to any maturation, practice, or other systematic influences. The advantage here, is that the average of two measurements will be more precise than any single measurement, so that provides a bit more certainty about the baseline test score.

In this case "larger" means larger than the T1 and T2 scores combined: "Is T3 larger than the average of T1 and T2?"

The second way of thinking about these scores is to assume that in addition to test-retest "noise", the change from T1 to T2 is also a systematic one that is related to practice effects, general maturation, or something else. In this case, we assume that the change from T1 to T2 would also occur in the time between T2 and T3 even without intervention.

In this second sense, "larger" means not just larger than T2, but enough larger that it can't just be attributed to maturation or time. "Is the change from T2 to T3 larger than the change from T1 to T2?"

Why not just use Howard's WEST-COL and WEST-ROC?

Howard et al.'s methods make use of item-level data, which is useful when you're conducting a reading test or other kind of "accuracy" or "speed" measure. e.g., when each item can be compared with each other in reasonable ways.

If your test doesn't work that way, say in a social anxiety questionnaire where the intervals between items may not have comparable psychological meaning, the item-level methods are no longer appropriate. We can, however, take the overall scores for the scale and use that to derive some useful values. Note that unless the test-retest reliabilities of your measure are very very high, this results in a considerably less powerful approach than the item-level approach that Howard et al. have developed.

¹By "known" here, I just mean well-estimated with a large sample

The Math

In both of the scenarios described above, we are essentially taking three random variables (the measurements at T1, T2, and T3) and combining them into a new random variable.

COL: $X_{COL} = T3 - \frac{T1+T2}{2}$

ROC: $X_{ROC} = (T3 - T2) - (T2 - T1)$ which can be rewritten in the simpler form $X_{ROC} = T3 - 2 \cdot T2 + T1$

What this means is that if we can work out the mean and standard deviations of X_{COL} and X_{ROC} under the null hypothesis that there are no effects of treatment, then we can use the simple normal distribution rule that forms the basis of most null hypothesis testing.

$$X_{crit} = \bar{X} \pm z_{\alpha} \sigma_X$$

where \bar{X} is the expected mean of X , z_{α} is the standard normal value associated with alpha-level α , and σ_X is the standard deviation of the X scores.

The trick is calculating \bar{X} and σ_X under the null hypothesis.

Distribution of the COL score

First let's consider the easier situation, where there is nothing about the test that would imply a change with time. For example, if you were indexing social anxiety scores 8 wks apart, practice effects aren't relevant since there are no right or wrong answers, and maturation is unlikely to produce systematic changes on this short timescale.

What we want to know is whether the scores at T3 are larger than we would expect given the scores at T2 and T1.

One assumption I'm making for the rest of this treatment is that T1, T2, and T3 are all distributed as $N(\mu, \sigma^2)$, where σ^2 is constant for all three tests. Under the null hypothesis, H_0 , we further assume that treatment makes no difference to test scores. Consequently, test scores will have identical μ s. (Another assumption is that the test-retest reliability isn't changing so that the correlation between T1 and T2, and T2 and T3, and T1 and T3 are all the same.)

What we need to do is work out what the distribution of the COL score is:

$$X_{COL} = T3 - (T1 + T2)/2$$

Mean of X_{COL}

To get the expected mean, it turns out to be simply

$$\bar{X}_{COL} = E(T3) - E(T1 + T2)/2$$

$$\bar{X}_{COL} = \mu - (\mu + \mu)/2 = \mu - \mu = 0$$

Variance of Linear Combinations of Variables

The standard deviation is just the square root of the variance, so this discussion will be about variances.

There are two well-known features of variances that we can take advantage of here.

First, the variance of a linear combination of variables is a function of the individual variances, and the covariance of the variables:

CHAPTER 7

General Discussion

GENERAL DISCUSSION

In this thesis, we have presented a series of studies that were designed to improve our understanding of the association between poor reading and anxiety. To this end, we addressed five specific aims. We aimed to investigate the strength and reliability of the association between poor reading and anxiety (Aim 1), to explore if there is an association between certain types of poor reading and anxiety (Aim 2), to start to formulate a causal hypothesis explaining the association between poor reading and anxiety (Aim 3), to develop an integrated treatment for children with concomitant poor reading and anxiety (Aim 4), and to evaluate the suitability and efficacy of Cool Reading for children with poor reading and anxiety (Aim 5). Below, we summarise our findings in relation to each aim in turn, before considering the current limitations and future directions for this field of research.

Aim 1: To measure the strength and reliability of the association between poor reading and anxiety

To address our first aim, we conducted the first systematic review and meta-analysis to investigate whether there is a reliable association between poor reading and anxiety (Chapter 2). In this review, we included studies that investigated associations between poor reading and internalising problems (i.e., combined measures of anxiety and depression), anxiety, and depression. Adhering to rigorous inclusion criteria, our systematic search identified 34 studies comprising 16,275 participants ($N = 2,491$ poor readers). The results showed significant differences between poor readers and typical readers on general measures of internalising problems ($d = 0.41$), as well as specific measures of anxiety ($d = 0.41$) and depression ($d = 0.23$). These results suggest that there is a moderate and reliable association between poor reading and internalising problems which is most likely driven by anxiety rather than depression.

Aim 2: To determine if there is an association between certain types of poor reading and anxiety

While our systematic review and meta-analysis indicated that poor readers are at risk for anxiety, it was not designed to identify whether certain types of poor reading (e.g. poor fluency) are associated with particular types of anxiety (e.g., social anxiety). Hence, we conducted a “profiling” study to explore if concurrent poor reading and anxiety problems in children are associated with particular types of reading problems or anxiety symptoms. In Chapter 3, we compared four groups of children (poor readers with anxiety, poor readers without anxiety, typical readers with anxiety, normative control children) for different types of reading (phonological recoding, visual word recognition, reading fluency, reading comprehension) and anxiety problems (social anxiety, separation anxiety, generalised anxiety, panic/agoraphobia, physical injury fears, obsessive-compulsive symptoms). We also examined these types of reading and anxiety in 11 children who participated in our pilot and interventional case studies in Chapter 5 and Chapter 6.

Focusing first on reading, Table 1 shows the types of poor reading that were identified in our poor readers with anxiety across our three studies. This table reveals that a large proportion of children had poor phonological recoding skills (85.55%), poor visual word recognition skills (69.99%), poor word reading fluency (76.99%), and poor reading comprehension (55.55%). Considered together, these results suggest that poor readers with anxiety may have fundamental problems learning to read both regular and irregular words (via phonological recoding and visual word recognition), which has knock-on effects on reading fluency and reading comprehension. Interestingly, our results in the profiling study (Chapter 3) suggest that poor readers without anxiety have more specific reading problems with reading regular words via phonological recoding. However, this finding, which is based

on a relatively small sample, requires more empirical investigation before it can be considered reliable.

Table 1
Types of reading problems in poor readers with anxiety

	Profiling	Pilot	Case series		Total	
	<i>n</i> / 34	<i>n</i> / 4	<i>n</i> / 7	<i>n</i> / 45	%	%
Word accuracy						
Phonological recoding						
Nonword reading accuracy	27	3	7	37	82.22%	85.55%
Nonword spelling	29	4	7	40	88.88%	
Visual word recognition						
Irregular reading accuracy	25	3	7	35	77.77%	69.99%
Irregular word spelling	20	2	6	28	62.22%	
Reading fluency						
Word reading fluency	25	4	7	36	80.00%	76.66%
Nonword fluency	24	3	6	33	73.33%	
Reading comprehension	16	2	7	25	55.55%	55.55%

Note. We used the Test of Everyday Reading Comprehension in the profiling study and the Neale Analysis of Reading Ability in the pilot and interventional case series study to measure reading comprehension. Grey cells indicate the proportion of children performing in the clinically elevated range was above 50%.

Turning to anxiety, Table 2 shows the types of anxiety experienced by our poor readers with anxiety across the studies. Across all studies, a large proportion of poor readers with anxiety had elevated social anxiety symptoms (60.00 to 62.22%) and social anxiety disorder (90.91%), generalised anxiety symptoms (80.00%) and generalised anxiety disorder (90.91%), and separation anxiety symptoms (60.00%) and separation anxiety disorder (90.91%). Interestingly, 90% of our poor readers with anxiety were diagnosed with specific phobias in our pilot and interventional case series studies, but majority of children were not elevated on physical injury fears across the studies. Combined with the reading outcomes, these findings suggest that the poor readers with different types of anxiety (social anxiety, generalised anxiety, and/or separation anxiety) have poor visual word recognition and poor phonological recoding.

Table 2
Types of anxiety problems in poor readers with anxiety

	Profiling study /34	Pilot study / 4	Case series study / 7	Proportion
Social anxiety				
Social anxiety disorder	n/a	4	6	90.91%
Social anxiety SCAS-P	17	4	6	60.00%
Social anxiety SPAI-P	19	4	5	62.22%
Social anxiety SCAS-C	10	2	1	28.89%
Social anxiety SPAI-C	17	1	2	44.44%
Generalised anxiety				
Generalised anxiety disorder	n/a	4	6	90.91%
Generalised anxiety SCAS-P	26	4	6	80.00%
Generalised anxiety SCAS-C	8	1	3	26.67%
Separation anxiety				
Separation anxiety disorder	n/a	3	3	54.55%
Separation anxiety SCAS-P	17	4	6	60.00%
Separation anxiety SCAS-C	13	1	2	35.56%
Phobias				
Specific phobia	n/a	4	6	90%
Physical injury fears SCAS-P	15	4	2	46.67%
Physical injury fears SCAS-C	15	1	3	42.22%
Obsessive-compulsive				
Obsessive-compulsive disorder	n/a	0	0	0.00%
Obsessive-compulsive SCAS-P	10	2	2	31.11%
Obsessive-compulsive SCAS-C	13	1	3	37.78%
Panic				
Panic disorder	n/a	0	0	0.00%
Panic/agoraphobia SCAS-P	14	4	5	51.11%
Panic/agoraphobia SCAS-C	6	1	3	22.22%

**Aim 3: To start to formulate a causal hypothesis explaining the association between
poor reading and anxiety**

The results arising from addressing Aim 1 and Aim 2 clearly suggest that there is a reliable association between reading and anxiety. However, we currently lack a comprehensive evidence-based theory explaining the mechanisms that are responsible for this association. One aim of Chapter 3 was to start to assemble such a theory by measuring and comparing four variables that could potentially link poor reading and anxiety (poor reading self-concept, poor peer relations, poor behaviour, poor attention) in four groups of children (poor readers with anxiety, poor readers without anxiety, typical readers with anxiety, normative control children). We also assessed these "linking variables" in the 11 children

who participated in the pilot and interventional case series studies outlined in Chapter 5 and Chapter 6.

Table 3 compares the outcomes for the linking variables across the three studies. This comparison reveals that a large proportion of poor readers with anxiety have poor reading self-concept (62.22%) and poor attention (57.77%), while comparatively fewer children have peer problems (35.55 to 36.63%) or behaviour problems (17.77 to 36.63%). Considered together, the results from these studies suggest that poor reading self-concept and poor attention are more prevalent in poor readers with anxiety than poor readers without anxiety (poor reading controls) or typical readers with anxiety (anxiety controls). Thus, the profiles of poor readers with anxiety appear to be characterised by poor reading self-concept and poor attention. This raises the possibility that poor reading self-concept and poor attention act as mechanisms linking poor reading and anxiety. Specifically, as outlined in Chapter 3, children with multiple word reading problems may repeatedly experience reading failure in the classroom (Riddick, Sterling, Farmer, & Morgan, 1999). This repeated failure may become evident to the children themselves, which may lead them to form the self-perception that they are poor readers (Chapman et al., 2001; Mercer, 2005; Morgan & Fuchs, 2007). This poor reading self-concept may trigger heightened awareness about the threat of negative evaluation from their peers and teachers, which is social anxiety. This increased focus on potential negative evaluation and avoidance of such may interfere with the child's ability to pay attention in the classroom (Bogels & Mansell, 2004; Mogg et al., 1997) which would reduce their engagement in reading activities. This would cause a child to fall even further behind their peers in their reading skills, further erode their reading self-concept and heighten their social anxiety. Thus, a vicious cycle of failure is created and maintained over time.

The validity of this hypothesis, which is based solely on cross-sectional data, needs to be tested in future intervention studies that explore the effects of (1) improving reading on

reading self-concept, attention, and anxiety; and (2) improving anxiety on reading self-concept, attention, and reading. Therefore, this thesis has laid the foundations for a comprehensive evidence-based theory explaining the association between poor reading and anxiety, and provided clear directions for how future research studies might further develop this theory.

Table 3
Linking variable problems in poor readers with anxiety

	Profiling study <i>n</i> / 34	Pilot study <i>n</i> / 4	Case series <i>n</i> / 7	Total <i>n</i>	%
Reading self-concept (RSCS; raw scores)	20	3	5	28 / 45	62.22
Peer problems (SDQ-P; raw scores)	11	1	4	16 / 45	35.55
Peer relationships (Conners-P; <i>T</i> -scores)	n/a	0	4	4 / 11	36.36
Inattention (Conners-P; <i>T</i> -scores)	n/a	3	5	8 / 11	72.72
Hyperactivity (Conners-P; <i>T</i> -scores)	n/a	4	3	7 / 11	63.63
Attention problems (SDQ-P; raw scores)	17	4	5	26 / 45	57.77
Conduct symptoms (SDQ-P/raw scores)	8	0	0	8 / 45	17.77
Defiance and aggression (Conners-P/ <i>T</i> -scores)	n/a	2	2	4 / 11	36.36

Note. Grey cells indicate the proportion of children performing in the clinically elevated range was above 50%.

Aim 4: To develop an integrated treatment for children with concomitant poor reading and anxiety

The fourth aim of this dissertation focused on the treatment of children with concomitant poor reading and anxiety. We developed Cool Reading which, to our knowledge, is the first integrated reading and anxiety intervention for children (Chapter 4). Based on the existing scientific evidence, Cool Reading was designed to include reading treatment components for word reading accuracy, reading fluency, and reading comprehension. Treatment for each of these components was delivered using evidence-based intervention tools, many developed by the Macquarie University Reading Clinic. The anxiety treatment components in Cool Reading were based on the core and specific treatment

components of the Cool Kids programme – a highly-effective evidence-based intervention for childhood anxiety. The Cool Kids anxiety treatment components were modified so that they could be understood and tolerated by children who struggle with reading. For example, workbook activities were simplified, cartoons were used instead of written instructions, and written exercises were reduced to minimum.

Aim 5: To evaluate the suitability and efficacy of Cool Reading for children with poor reading and anxiety

The final aim of this dissertation was to determine the suitability and efficacy of Cool Reading for children with concomitant reading and anxiety difficulties. To assess suitability, we recruited four children for a pilot interventional case series study of the original version of Cool Reading. We used this pilot study to (1) determine if the procedures needed to be refined to better suit children who had both poor reading and anxiety (Chapter 5), and (2) start to explore if Cool Reading has an effect on reading and anxiety outcomes. We did not collect control data in this pilot study hence any outcome gains were considered suggestive rather than definitive.

The results suggested that the anxiety treatment materials were easily accessible to the children during the intervention. In terms of reading outcomes, the data suggested that Cool Reading may have a positive effect on general reading skills (regular word reading accuracy, reading comprehension), the nonlexical reading route (nonword reading accuracy, nonword spelling accuracy), the lexical route (irregular word spelling), and one cognitive component of the nonlexical reading route (GPC knowledge). In terms of anxiety, the outcomes suggested that Cool Reading may not have an effect on primary anxiety disorders (0%), but may have had an effect on overall anxiety disorder diagnoses (36%; social anxiety disorder, separation anxiety disorder, specific phobias), anxiety symptoms (social anxiety symptoms, generalised anxiety symptoms, physical injury fears), and anxiety interference (home

interference, outside home interference). The effect of Cool Reading on anxiety was lower than expected, which prompted changes to the anxiety treatment components. Specifically, we added modified versions of social anxiety treatment components from the Cool Kids Social programme into a revised version of Cool Reading. We also introduced Gradual Exposures earlier.

In the final study of this dissertation (Chapter 6), we measured the effects of the revised version of Cool Reading on reading and anxiety outcomes in a second interventional case series study. This study was the same as the pilot study (Chapter 5) except that it included (1) a larger number of individual cases (seven children with concomitant reading and anxiety difficulties), (2) control data using a double-baseline non-treatment period, and (3) additional reading measures to evaluate the specific effects of Cool Reading on the reading cognitive system.

In terms of reading outcomes, we found that Cool Reading had a significant effect on general reading skills (regular word reading accuracy), the nonlexical reading route (nonword reading accuracy, nonword spelling accuracy), the lexical reading route (irregular word spelling, sight word spelling), and components of the nonlexical route (GPC knowledge) at the group level and in the majority of individuals. Table 4 compares these outcomes to those of the pilot study in Chapter 5. The results of both studies clearly showed that Cool Reading had a significant and positive effect at the group and individual level for reading skills that were trained directly and explicitly, but not for reading skills that were trained indirectly or not trained at all. Thus, the reading treatments in Cool Reading significantly improved reading skills that are directly trained for poor readers with anxiety.

In terms of anxiety, the interventional case series study (Chapter 6) found that Cool Reading had a significant effect at the group and individual level on primary anxiety disorders (social anxiety disorder, generalised anxiety disorder, separation anxiety disorder,

specific phobias), anxiety symptoms (social anxiety symptoms, generalised anxiety symptoms, separation anxiety symptoms), and anxiety interference (home interference, outside of home interference, parent life interference). Tables 5 and 6 compare these effects to the anxiety outcomes in the pilot study in Chapter 5. The results of both studies showed that Cool Reading had a significant and positive effect at the group and individual level for social anxiety disorder and social anxiety symptoms. However, the improvements were greater for anxiety disorders, anxiety symptoms, and anxiety interference in the latter interventional case series than the pilot study. The improved outcomes are likely due to the refinements that we made to Cool Reading after the pilot study. Thus, our new version of Cool Reading significantly improved anxiety outcomes at the group and individual level for poor readers with anxiety.

Table 4

Summary of changes in scores for individual participants (pilot study and case series) and for the group (case series only) on the reading outcome measures

Outcome		CS	Pilot study				Total n / 4	CL	ZK	YR	Case series				Group	Total n / 7	Total n / 11	%
			AC	BK	RC						CG	RF	JA	FM				
General reading																		
Regular reading accuracy		ns	*	ns	*	2/4	*	*	ns	ns	ns	ns	ns	*	*	3/7	5/11	45%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Word reading fluency		ns	*	ns	ns	1/4	*	ns	ns	ns	ns	ns	ns	ns	ns	1/7	2/11	18%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Text reading fluency		ns	ns	*	ns	1/4	*	ns	ns	ns	ns	ns	ns	ns	ns	1/7	2/11	18%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Reading comprehension		*	ns	*	*	3/4	ns	ns	ns	ns	*	ns	ns	ns	ns	1/7	4/11	36%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Nonlexical reading route																		
Nonword reading accuracy		*	ns	ns	*	2/4	*	ns	ns	*	*	ns	*	*	*	4/7	6/11	54%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Nonword reading fluency		ns	*	ns	*	2/4	ns	*	ns	*	ns	ns	ns	ns	ns	2/7	4/11	36%
	Trained	X	X	X	X		X	X	X	X	X	X	X	X				
Nonword spelling		ns	ns	*	ns	1/4	*	*	ns	ns	ns	ns	ns	ns	*	2/7	3/11	27%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Lexical reading route																		
Irregular reading accuracy		ns	ns	ns	ns	0/4	ns	ns	ns	ns	ns	ns	ns	ns	ns	0/7	0/11	0%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Irregular word spelling		ns	ns	*	*	2/4	*	*	ns	*	*	ns	ns	ns	*	4/7	6/11	54%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Trained spelling sight word							*	*	*	*	*	*	*	*	*	7/7	7/7	100%
	Trained			not assessed				✓	✓	✓	✓	✓	✓	✓				
Trained reading sight words							ns	*	*	ns	ns	ns	ns	ns	ns	2/7	2/7	18%
	Trained			not assessed				✓	✓	✓	✓	✓	✓	✓				
Individual components of both routes																		
Letter identification							ns	ns	ns	ns	ns	ns	ns	ns	ns	0/7	0/7	0%
	Trained		no RCI values				✓	✓	✓	✓	✓	✓	✓	✓				
							(indirect)											
Letter position encoding							ns	*	*	*	ns	ns	ns	ns	ns	3/7	3/7	42%
	Trained (indirectly)			not assessed				✓	✓	✓	✓	✓	✓	✓	✓			
Nonword repetition				not assessed				ns	ns	ns	ns	*	ns	ns	ns	1/7	1/7	14%

Trained (indirectly)							✓	✓	✓	✓	✓	✓	✓	✓				
Nonlexical route																		
GPC knowledge graphemes	ns	*	ns	*	2/4	ns	*	ns	*	ns	*	*	*	4/7	6/11	54%		
	Trained	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
GPC knowledge nonwords						*	*	ns	*	ns	ns	*	*	4/7	4/7	57%		
	Trained		no RCI values				✓	✓	✓	✓	✓	✓	✓					
PGC knowledge nonwords						*	*	*	*	*	*	*	*	7/7	7/7	100%		
	Trained		no RCI values				✓	✓	✓	✓	✓	✓	✓					
Nonword blending						ns	ns	ns	ns	ns	ns	ns	ns	0/7	0/7	0%		
	Trained (indirectly)		not assessed				✓	✓	✓	✓	✓	✓	✓					
Nonword segmenting						*	ns	ns	*	ns	ns	ns	ns	2/7	2/7	28%		
	Trained (indirectly)		not assessed				✓	✓	✓	✓	✓	✓	✓					
Components of the lexical route																		
Orthographic lexicon	ns	ns	ns	ns	0/4	ns	ns	ns	ns	ns	ns	ns	ns	0/7	0/11	0%		
	Trained	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Orthographic-semantics link						*	ns	ns	ns	ns	ns	ns	ns	1/7	1/11	9%		
	Trained		no RCI values				X	X	X	X	X	X	X					
Picture naming						ns	ns	ns	ns	*	ns	ns	ns	1/7	1/7	9%		
	Trained		not assessed				X	X	X	X	X	X	X					
Semantics						ns	ns	ns	ns	ns	ns	ns	ns	0/7	0/7	0%		
	Trained		not assessed				X	X	X	X	X	X	X					

Table 5

Diagnostic remission rates for all participants on the outcome measures for anxiety disorders.

	Pilot study		Case series		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i> / <i>N</i>	%
All diagnoses	0/4	0%	3/7	42%	3/11	27%
Primary disorder	0/4	0%	4/7	57%	4/11	36%
Social anxiety disorder	2/4	50%	5/6	83%	7 / 10	70%
Generalised anxiety disorder	0/4	0%	4/5	80%	4 / 9	44%
Separation anxiety disorder	2/3	66%	1/3	33%	3 / 6	50%
Specific phobia	2/6	33%	17/20	85%	19 / 26	73%
Total disorder remission	6/18	33%	27 / 34	79%	33 / 52	63%

Table 6

Raw score improvements for all participants on the outcome measures for anxiety

Outcome measure		Pilot study				Case series								Group	Total	Total	
		CS	AC	BK	RC	Total	CL	ZK	YR	CG	RF	JA	FM				
Anxiety disorders																	
Social anxiety disorder		*	ns	ns	*	2/4	ns	*	ND	*	*	*	*	*	5/6	7 / 10	70%
	Trained	✓	✓	✓	✓		✓	✓	X	✓	✓	✓	✓				
Generalised anxiety disorder		ns	ns	ns	ns	0/4	*	ND	*	*	ND	ns	*	*	4/6	4 / 9	44%
	Trained	✓	✓	✓	✓		✓	X	✓	✓	X	✓	✓				
Separation anxiety disorder		*	*	ns	ND	2/3	ND	ns	ND	ns	*	ND	ND	ns	1/3	3 / 6	50%
	Trained	✓	✓	✓	X		X	✓	X	✓	✓	X	X				
Anxiety symptoms																	
Social anxiety SCAS-P		*	*	ns	ns	2/4	*	ns	ns	*	*	*	ns	*	4/7	6/11	54%
Social anxiety SPAI-P			no RCI available				ns	ns	ns	ns	ns	ns	ns	*	0/7	0/11	0%
Social anxiety SPAI-C		*	ns	ns	ns	1/4	*	*	ns	ns	*	ns	ns	ns	3/7	4/11	36%
Social anxiety SCAS-C		ns	ns	ns	ns	0/4	*	ns	ns	ns	*	ns	ns	ns	1/7	1/11	9%
	Trained	✓	✓	✓	✓		✓	✓	X	✓	✓	✓	✓				
Generalised anxiety SCAS-P		ns	*	*	ns	2/4	ns	*	ns	*	*	*	ns	*	4/7	6/11	54%
Generalised anxiety SCAS-C		ns	ns	ns	ns	0/4	*	ns	ns	ns	ns	ns	ns	*	1/7	1/11	9%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Separation anxiety SCAS-P		ns	ns	ns	*	1/4	*	*	ns	ns	ns	*	ns	*	3/7	4/11	36%
Separation anxiety SCAS-C		ns	ns	ns	ns	0/4	*	*	*	ns	*	ns	ns	ns	4/7	4/11	36%
	Trained	✓	✓	✓	X		X	✓	X	✓	✓	X	X				
Physical injury fears SCAS-P		ns	*	ns	ns	1/4	ns	ns	*	ns	ns	ns	ns	ns	1/7	2/11	18%
Physical injury fears SCAS-C		ns	*	ns	ns	1/4	ns	ns	ns	*	ns	ns	ns	ns	1/7	2/11	18%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Obsessive-compulsive SCAS-P		ns	ns	ns	*	1/4	*	ns	ns	ns	ns	ns	ns	ns	1/7	2/11	18%
Obsessive-compulsive SCAS-C		ns	ns	ns	ns	0/4	*	*	*	ns	*	*	ns	*	5/7	5/11	45%
	Trained	X	X	X	X		X	X	X	X	X	X	X				
Panic/agoraphobia SCAS-P		ns	*	ns	ns	1/4	ns	ns	ns	*	ns	ns	ns	*	1/7	2/11	18%
Panic/agoraphobia SCAS-C		ns	ns	ns	ns	0/4	ns	ns	ns	*	*	ns	ns	*	2/7	2/11	18%
	Trained	X	X	X	X		X	X	X	X	X	X	X				
Total anxiety SCAS-P		ns	*	ns	ns	1/4	*	*	ns	*	*	*	ns	*	5/7	6/11	54%
Total anxiety SCAS-C		ns	ns	ns	ns	0/4	*	ns	ns	ns	*	ns	ns	*	2/7	2/11	18%
		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Anxiety interference																	

GENERAL DISCUSSION

Home CALIS-P		ns	*	ns	ns	1/4	*	*	*	*	*	*	ns	*	6/7	7/11	63%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Home CALIS-C		ns	ns	ns	ns	0/4	*	ns	*	*	*	ns	*	*	5/7	5/11	45%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Outside CALIS-P		ns	ns	ns	*	1/4	ns	*	ns	ns	ns	*	ns	*	2/7	3/11	27%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Outside CALIS-C		*	*	ns	*	3/4	*	ns	ns	*	*	*	ns	ns	4/7	7/11	63%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Parent life CALIS-P		ns	ns	*	*	2/4	*	ns	*	*	ns	ns	ns	*	3/7	5/11	45%
	Trained	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				

Limitations and future directions

We have acknowledged the limitations of the research studies throughout this dissertation. In an effort to minimise repetition, the limitations of the individual studies can be summarised as follows. In the systematic review and meta-analysis, we identified that the existing literature was limited by the heterogeneity of poor reading and anxiety, poor reporting of participant characteristics, and reliance on dimensional questionnaires to assess anxiety (see Chapter 2). We addressed two of these limitations in the profiling study in Chapter 3 by evaluating whether there were specific associations between different types of poor reading (e.g., poor reading fluency) and different types of anxiety (e.g., social anxiety, generalised anxiety). We also addressed the poor reporting of participant characteristics by “profiling” children on reading self-concept, peer relationship, attention, and behaviour problems and obtaining detailed information on children’s developmental history. In doing so, we discovered that poor readers with anxiety are characterised by multiple word reading problems and social anxiety, as well as poor reading self-concept and poor attention.

Despite its methodological improvements, the profiling study continued to be limited by cross-sectional data, as well as small sample sizes, multiple comparisons, and reliance on dimensional questionnaires. We addressed the last limitation - reliance on dimensional questionnaires – in our pilot study (see Chapter 5) by complementing these questionnaires with a diagnostic interview to measure anxiety disorders. This approach revealed that social anxiety disorder, generalised anxiety disorder, separation anxiety disorder, and specific phobias were particularly prevalent in poor readers with anxiety.

A critical (though planned) limitation of the pilot study was the absence of any control data. This necessitated statistical analyses that were either highly conservative (i.e., for variables with existing reliability indices) or purely descriptive (i.e., for variables that did not have existing reliability properties). In our final interventional case series in Chapter 6,

we addressed the lack of control data by implementing a within-subjects double baseline control period. This new study supported the pilot study in suggesting that Cool Reading is effective for improving impairments in reading and anxiety that are both directly trained *and* directly tested.

The importance of direct training came as no surprise: Human research has repeatedly demonstrated that training effects are greatest for skills trained directly. These specific effects have been found for studies in exercise physiology (McCafferty & Horvath, 1977), physiological responses (Reilly, Morris, & Whyte, 2009), improved balance (Kummel, Kramer, Giboin, & Gruber, 2016), general skill learning (Green & Bavelier, 2008) – and reading (Schuett, Heywood, Kentridge, Dauner, & Zihl, 2012; McArthur et al., 2012; 2015a; 2015b; 2018). The importance of direct testing had a greater impact on our understanding since it cemented our growing realisation that the extent of an intervention effect can only be fully understood by using outcome measures that include trained and untrained items (e.g., trained and untrained irregular words). This is not common practice in group studies of reading intervention, which often use standardised and normed tests that may (or may not) coincidentally include items that are trained (e.g., trained GPCs or trained words). Our pilot study and interventional case series included some measures that were designed to index trained items specifically (e.g., the Letter-Sound Test: Larsen, Kohnen, Nickels, & McArthur, 2015; the Diagnostic Reading Test for nonwords: Colenbrander, Kohnen, & Nickels, 2011; the Diagnostic Spelling Test for Nonwords: Kohnen, Nickels, & Castles, 2009; the Macquarie University Reading Clinic Sight Word Reading and Spelling Lists: Kohnen & Banales, 2015), but in line with previous group studies, we also included standardised and normed tests that did not necessarily include trained items. These were the tests that did not show treatment effects. We therefore recommend that studies of combined reading and anxiety interventions – including any future RCT of Cool Reading – employ outcome

measures that include trained and untrained items for a more complete understanding of the degree of specificity and generalisation of the training effects under scrutiny.

We would further recommend that a future RCT of Cool Reading include a Cool Reading group, untreated waitlist control group, a reading treatment group, and an anxiety treatment group. Comparison of the Cool Reading and untrained control groups would reveal whether Cool Reading was better than no treatment at all, and comparison of the Cool Reading group to the reading group and the anxiety group would reveal if integrated reading and anxiety treatment is more effective than either treatment alone. The Cool Reading, reading, and anxiety groups should all receive the same dose of training over the same period of time, hence the treatment sessions for the reading and anxiety groups would be around half the length of 1-hour Cool Reading sessions, which should be administered three times per week for 12 weeks. All training could be completed in a clinic or from home via Zoom. The Cool Reading and anxiety groups should additionally receive a weekly 30-minute parent consult via phone to support children's anxiety training.

The outcomes of this RCT could be assessed before and after the 12-week training period to assess the immediate effects of Cool Reading, and after a subsequent 12-week period of no training to assess the retention or decay of treatment effects. Based on the findings in this thesis, the reading outcomes should include both trained and untrained sets of items for each type of reading skill that is trained. The anxiety outcomes could be narrowed down to the types of anxiety that are impaired, and hence trained, in each child. Similarly, "linking variables" could be pared down to reading self-concept and attention. Assessment of all outcomes should be done by assessors who are blind to group allocation.

The RCT should include at least 64 children with poor reading and anxiety in each group to ensure it had adequate power (80%) to detect moderate effect sizes with an alpha of 0.05 (Ellis, 2010). Since these groups comprise less than 100 participants, children should be

randomly allocated to groups using minimisation that uses word reading accuracy, social anxiety, and age as factors. The children could be aged from 8 to 12 years since early detection and intervention is best practice. Participants with developmental disorders such as autism, attention deficit/hyperactivity disorder, or depression, should be excluded since these problems may limit response to combined reading and anxiety treatment.

A final methodological issue to note, which might be perceived to affect the outcomes of our studies, is the absence of statistical correction for multiple comparisons. Correction for multiple comparisons is a controversial topic. Some researchers argue that statistical corrections should be made for all repeated comparisons within a study to avoid Type 1 errors (Aicken, 1999; Aicken & Gensler, 1996; Feise, 2002; Neyman & Pearson, 1928). Others argue that such corrections are unnecessary when informed logic is applied to interpreting patterns of outcomes, and are unwise because (1) corrections reduce the power to detect real effects (i.e., increase Type II errors), and (2) there is no clear definitions of what constitutes a multiple comparison (Bender & Lange, 2001; Feise, 2002; Glickman, Rao, & Schultz, 2014; Jackson et al., 2015; McKeon et al., 2016; Perninger, 2008; 2009). Our experience aligns with the latter argument, and hence we minimised Type 1 errors in this thesis via replication and reliability rather than statistical correction. We believe this approach was successful for the following two reasons. First, the outcomes of the profiling, pilot, and interventional case series studies consistently showed that word reading accuracy, reading self-concept, social anxiety, and poor attention were particularly prevalent in poor readers with anxiety – but not peer relationship problems or behaviour problems. Second, the pattern of intervention effects in the pilot study and interventional case series were very similar. Specifically, children showed significant improvements in general reading skills, nonlexical reading, and lexical processes as well as improvements in anxiety disorders,

anxiety symptoms, and anxiety interference. Thus, the consistent pattern of findings across the studies argue against the influence of Type I errors on our results.

Summary

The general aim of the studies described in this dissertation was to better understand the association between poor reading and anxiety. Specifically, we aimed to investigate the strength and reliability of the association between poor reading and anxiety (Aim 1), evaluate the association between certain types of poor reading and anxiety (Aim 2), formulate a potential causal hypothesis explaining the association between poor reading and anxiety (Aim 3), develop an integrated treatment for children with concomitant poor reading and anxiety (Aim 4), and evaluate the suitability and efficacy of Cool Reading for children with poor reading and anxiety (Aim 5). This dissertation addressed these aims in five studies. In the first study, we conducted a systematic review and meta-analysis of the association between poor reading and anxiety. Then, we conducted a profiling study investigating the potential linking variables, specific reading impairments, and types of anxiety associated with concomitant poor reading and anxiety. Following this, we developed Cool Reading – the first integrated reading and anxiety intervention for poor readers with anxiety. We then conducted a pilot study to refine the procedures of Cool Reading. Finally, we conducted an interventional case series that examined the effect of Cool Reading on reading and anxiety outcomes.

In line with our aims, we discovered that poor readers are at risk for anxiety (Aim 1), and that they have broad and severe reading difficulties, as well as specific problems with social anxiety, as well as generalised anxiety and separation anxiety (Aim 2). We also discovered that poor reading self-concept and poor attention are particularly prevalent in poor readers with anxiety (Aim 3). We developed the first integrated reading and anxiety treatment

for children, which we called Cool Reading (Aim 4), and we discovered that this intervention has a positive and significant effect on reading and anxiety skills that are directly trained and directly tested (Aim 5). Considered together, the outcomes of this dissertation have enriched our knowledge of, and treatment for, poor reading and anxiety, which will ultimately improve the lives of children with these disorders.

REFERENCES

- Aickin, M., & Gensler, H. (1996). Adjusting for multiple testing when reporting research results: the Bonferroni vs Holm methods. *American Journal of Public Health, 86*, 726-728. doi: 10.2105/ajph.86.5.726
- Aickin, M. (1999). Other method for adjustment of multiple testing exists. *BMJ, 127*, 318. doi: 10.1136/bmj.318.7176.127a
- Barrett, P., & Turner, C. 2001. Prevention of anxiety symptoms in primary school children: Preliminary results from a universal school-based trial. *British Journal of Clinical Psychology, 40*: 399–410. doi: 10.1348/014466501163887
- Bender, R., & Lange, S. (2001). Adjusting for multiple testing—when and how? *Journal of Clinical Epidemiology, 54*, 343–349. doi: 10.1016/S0895-4356(00)00314-0
- Benson, N.J., Lovett, M.W. & Kroeber, C.L. (1997). Training and transfer-of-learning effects in disabled and normal readers: Evidence of specific deficits. *Journal of Experimental Child Psychology, 64*, 343–366. doi: 10.1006/jecp.1996.2342
- Broom, Y. M. & Doctor, E.A. (1995). Developmental surface dyslexia: A case study of the efficacy of a remediation programme. *Cognitive Neuropsychology, 12*, 69–110. doi: 10.1080/02643299508251992
- Chen, V., & Savage, R. S. (2014). Evidence for a simplicity principle: Teaching common complex grapheme-to-phonemes improves reading and motivation in at-risk readers. *Journal of Research in Reading, 37*, 196-214. doi: 10.1111/1467-9817.12022

- Colenbrander, D., Kohnen, S., & Nickels, L. (2011). Diagnostic reading test for nonwords (DiRT). Retrieved from <http://www.motif.org.au>
- Ellis, P. D. (2010). *The Essential Guide to Effect Sizes: An Introduction to Statistical Power, Meta-Analysis and the Interpretation of Research Results*. United Kingdom: Cambridge University Press.
- Feise, R.J. (2002). Do multiple outcome measures require p-value adjustment? *BMC Medical Research Methodology*, 2, 1-4. doi: 10.1186/1471-2288-2-8
- Galuschka, K., Schulte-Körne, G. (2016). Clinical practice guideline: The diagnosis and treatment of reading and/or spelling disorders in children and adolescents. *Deutsches Arzteblatt International*, 113, 279-286. doi: 10.3238/arztebl.2016.0279
- Glickman, M.E., Rao, S.R., & Schultz, M.R. (2014). False discovery rate control is a recommended alternative to Bonferroni-type adjustments in health studies. *Journal of Clinical Epidemiology*, 67, 850–857. doi: 10.1016/j.jclinepi.2014.03.012
- Green, C. S., & Bavelier, D. (2008). Exercising your brain: A review of human brain plasticity and training-induced learning. *Psychology and Aging*, 23, 692-701. doi: 10.1037/a0014345
- Hirshfeld-Becker, D. R. et al. (2008). Cognitive-behavioural intervention with young anxious children. *Harvard Reviews of Psychiatry*, 16, 113-125. doi: 10.1080/10673220802073956
- Hudson J. L., Rapee, R.M., Deveney, C., Schniering, C.A., Lyneham, H., & Bovopoulos, N. (2009). Cognitive-behavioral treatment versus an active control for children and adolescents with anxiety disorders: A randomized trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 46, 533-544. doi: 10.1097/CHI.0b013e31819c2401

- Kohnen, S. & Banales, E. (2015c). *The Macquarie University Reading Clinic Sight words intervention program*. Sydney: Macquarie University.
- Kohnen, S., Nickels, L., & Castles, A. (2009). Diagnostic spelling test – Spelling nonwords to dictation. Retrieved from <http://www.motif.org.au>
- Kummel, J., Kramer, A., Giboin, L., & Gruber, M. (2016). Specificity of balance training in healthy individuals: A systematic review and meta-analysis. *Sports Medicine*, 46, 1261-1271. doi: 10.1007/s40279-016-0515-z
- Larsen, L., Kohnen, S., Nickels, L., & McArthur, G. (2015). The letter-sound test (LeST): A reliable and valid comprehensive measure of grapheme-phoneme knowledge. *Australian Journal of Learning Difficulties*, 20, 129-142. doi: 10.1080/19404158.2015.1037323
- Lovett, M.W., Borden, S.L., DeLuca, T., Lacerensa, L., Benson, N.J. & Brackstone, D. (1994). Treating the core deficits of developmental dyslexia: Evidence of transfer of learning after phonologically- and strategy-based reading training programs. *Developmental Psychology*, 30, 805–822. doi: 10.1037/0012-1649.30.6.805
- McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015a). Sight word and phonics training in children with dyslexia. *Journal of Learning Disabilities*, 48, 391-407. doi: 10.1177/0022219413504996
- McArthur, G., Kohnen, S., Jones, K., Eve, P., Banales, E., Larsen, L., & Castles, A. (2015b). Replicability of sight word training and phonics training in poor readers: A randomised controlled trial. *PeerJ* 3:e922. doi: 10.7717/peerj.922
- McCafferty, W. B., & Horvath, S. M. (1977). Specificity of exercise and specificity of training: A subcellular review. *Research Quarterly. American Alliance for Health*,

Physical Education and Recreation, 48, 358-371. doi:

10.1080/10671315.1977.10615433

Neyman, J., & Pearson, E.S. (1928). On the use and interpretation of certain test criteria for purposes of statistical inference. *Biometrika*, 20, 175-240. doi: 10.2307/2331945

NHMRC. (2000). *How to use the evidence: assessment and application of scientific evidence*. Canberra: National Health and Medical Research Council.

Perneger, T.V. (1998). What's wrong with Bonferroni adjustments. *BMJ*, 316, 1236-1238. doi: 10.1136/bmj.316.7139.1236

Perneger, T. V. (1999). Adjusting for multiple testing in studies is less important than other concerns. *BMJ*, 8, 1288-1288. doi: 10.1136/bmj.318.7193.1288a

Reilly, T., Morris, T., & White, G. (2009). The specificity of training prescription and physiological assessment: A review. *Journal of Sports Science*, 27, 575-589. doi: 10.1080/02640410902729741

Schuett, S., Heywood, C. A., Kentridge, R. W., Dauner, R., & Zihl, J. (2012). Rehabilitation of reading and visual exploration in visual field disorders: Transfer or specificity. *Brain*, 135, 912-921. doi: 10.1093/brain/awr356

Schniering, C. A., Hudson, J. L., & Rapee, R. M. (2000). Issues in the diagnosis and assessment of anxiety disorders in children and adolescents. *Clinical Psychology Review*, 20, 453-478. doi: 10.1016/S0272-7358(99)00037-9

Weekes, B., & Coltheart, M. (1996). Surface dyslexia and surface dysgraphia: Treatment studies and their theoretical implications. *Cognitive Neuropsychology*, 13, 277-315. doi: 10.1080/026432996382033

