Gender and Reading: Are There Really More Boys Than Girls Who Struggle With Reading?

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Requirements and Format of a Thesis by Publication

This statement provides an overview of the requirements and format of a thesis by publication, in relation to University and Departmental requisites.

A thesis by publication must form a distinct contribution to knowledge either by the discovery of new facts or by the exercise of independent critical power. The thesis as a whole should focus on a single project or set of related questions and should present an integrated body of work, reflecting a coherent program of research.

The basic structure of a thesis by publication is as follows:

- An introduction providing a coherent overview of the background of the thesis, the research questions and the structure and organization of the remaining chapters. The distinct contribution of the thesis should be clearly identified.

- A number of chapters each written in the format of self-contained journal articles. These chapters should be published, in press or submitted. Where articles are published, they do not need to be reformatted for inclusion in the thesis. Each chapter should be prefaced by a brief introduction outlining how the chapter fits into the program of research and, in the case of jointly authored chapters, the students' contribution should be clearly specified.

- The final chapter should provide an integrative conclusion, drawing together all the work described in the other parts of the thesis and relating this back to the issues raised in the Introduction.

The length for a thesis completed at the Macquarie University Special Education Centre should generally be 50,000-75,000 words for a Doctorate and 25,000-40,000 words for a Master of Philosophy.

Synopsis

It is commonly thought that more boys than girls are identified as having a reading disability, but the degree to which there might be more boys remains controversial. The purpose of this research was to examine the major themes and issues relating to the prevalence of boys identified as having a reading disability, and determine whether there really are more boys identified when these issues are addressed. This research examined the various ways in which reading disability has been previously defined and measured, and the subsequent impact on reported gender ratios. Empirical evidence supporting various explanations proposed to account for reported gender differences in reading was also examined. Methods of identifying and defining poor reading were proposed, including the use of large-scale assessments to calculate gender ratios. This research examined whether boys and girls differ across a range of reading and related skills, and whether differences were evident in the early school years. The issue of whether boys require different forms of reading remediation was also examined. It was found that there are more boys than girls who are poor readers, but gender ratios are not as high as previously thought. Across a range of reading and related skills, boys and girls are more similar than dissimilar, and make almost identical progress (gains) in reading. Effect sizes for gender differences were consistently small. It was concluded that gender is not a strong or consistent predictor of reading ability, and that boys do not require different remedial reading instruction to girls.

Statement of Candidate

I certify that the work in this thesis entitled "Gender and Reading: Are There Really More Boys Than Girls Who Struggle With Reading?" has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree to any other University or institution other than Macquarie University.

I also certify that the thesis is an original piece of research and my own work. Any help and assistance I have received in my research and the preparation of the thesis itself have been appropriately acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

The research presented in this thesis was approved by Macquarie University Ethics Review Committee, reference numbers: HE27JUN2008-R05957 on 14th December 2009; HE23NOV2007-D05571 on 17th June 2010; and 5201001395 on 29th November 2010 (ethics documentation is included in Appendix 3).

Lisa Margaret Limbrick ()

21 May 2012

Statement of Contribution

This is a statement of my contribution to this thesis and the jointly written papers included in it. The following is a list of the papers written in conjunction with Principal Supervisor Dr Alison Madelaine and Associate Supervisor Professor Kevin Wheldall.

1. Limbrick, L., Wheldall, K., & Madelaine, A. (2011a). *Methodological factors affecting reported gender ratios for reading disability.* Previously published as Limbrick, L., Wheldall, K., & Madelaine, A. (2008). Gender ratios for reading disability: Are there really more boys than girls who are low-progress readers? *Australian Journal of Learning Difficulties, 13*(2), 161-179.

I wrote the original and revised versions of this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

2. Limbrick, L., Wheldall, K., & Madelaine, A. (2011b). Why do more boys than girls have a reading disability? A review of the evidence. *Australasian Journal of Special Education, 35*(1), 1-24.

I wrote this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

3. Wheldall, K., & Limbrick, L. (2010). Do more boys than girls have reading problems? *Journal of Learning Disabilities, 43*(5), 418-429.

I wrote this paper with input from Professor Kevin Wheldall.

4. Limbrick, L., Wheldall, K., & Madelaine, A. (2010). Estimating gender ratios of poor reading using large-scale assessments. *Australian Journal of Education, 54*(2), 190-222.

I wrote this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

5. Limbrick, L., Madelaine, A., & Wheldall, K. (in press). Gender differences in oral reading fluency: Are there implications for identifying low-progress readers? *Special Education Perspectives.*

I wrote this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

6. Limbrick, L., Wheldall, K., & Madelaine, A. (2011c). *Reading and Related Skills in the Early School Years: Are Boys Really More Likely to Struggle?* Manuscript submitted for publication.

I wrote this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

7. Limbrick, L., Wheldall, K., & Madelaine, A. (in press). Do boys need different remedial reading instruction from girls? *Australian Journal of Learning Difficulties.*

I wrote this paper with input from Dr Alison Madelaine and Professor Kevin Wheldall.

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CHAPTER 1: INTRODUCTION

Chapter Overview

This Chapter introduces the purpose of the research. A background to the research provides a brief overview of the topic and rationale for the research, which form the basis for the overall research questions addressed. The research in this study has been reported in a combination of published and unpublished papers, presented as individual Chapters. An outline of the structure and research design of each Chapter is provided in this Chapter.

Purpose of the Research

The purpose of the research reported herein was to examine the major themes and issues relating to the prevalence of boys identified as having a reading disability, and to determine whether there really are more boys identified when these issues are addressed.

Background to the Research

It is commonly thought that there are more boys than girls who struggle with reading, or have a reading disability. Indeed, it has been previously reported that boys are significantly more likely to be identified as poor readers than girls, with a number of studies reporting sizeable gender gaps in reading (Hoskyn & Swanson, 2000; Jorm, Share, Matthews, MacLean, 1986; Katusic, Colligan, Barbaresi, Schaid, & Jacobsen, 2001; Miles, Haslum, & Wheeler, 1998; Rutter et al., 2004). In the past decade, it has also been demonstrated that girls outperform boys in reading on both national and international large-scale assessments. In Australia, a greater percentage of boys compared to girls have not reached the minimum national reading standards in Years 3, 5, 7 and 9 on the National Assessment Program - Literacy and Numeracy (NAPLAN), a

nationwide large-scale assessment covering reading, writing, punctuation and grammar, spelling and numeracy (ACARA, 2010). On the Programme for International Student Assessment (PISA), a large-scale assessment administered to 15-year-old students internationally, girls have consistently scored higher in reading than boys across all 41 countries in the years 2000, 2003 and 2006 (Lynn & Mikk, 2009; Machin & Pekkarinen, 2008). Similarly, in the US National Assessment of Education Progress (NAEP) results, girls outperformed boys in reading with a 15% gender gap reported (Baer, Baldi, Ayotte, & Green, 2007; Salahu-Din, Persky, & Miller, 2008). Not surprisingly, these findings have prompted various investigations into the educational outcomes of boys, conducted by governments and independent consultants particularly in Australia, the United States, and Canada (see, for example, Center on Education Policy, 2010; House of Representatives, 2002; Ontario Ministry of Education, 2009). The purpose of such inquiries has been to review the 'boy crisis' and consider ways of improving boys' educational outcomes, as well as reduce the reported gender gaps in reading. Consequently, numerous reading programs and initiatives have been developed to improve boys' reading, including programs to address boys' behaviour (Dos Santos Ellas, Marturano, de Almeida Motta, & Giurlani, 2003), increase levels of reading motivation (Atkinson, 2009; Dahlhauser, 2003; Gaynor & Stephen, 2006) and introduce the use of technology and computers to raise boys' interest in reading (Leino & Malin, 2006; Littleton, Wood, & Chera, 2006; Sokal & Katz, 2008).

Although it is widely reported there are more boys than girls struggling with reading, there is controversy regarding the *degree* to which there might be more boys than girls. Whereas some studies have reported gender ratios for poor reading of approximately 2:1

(Chan, Ho, Tsang, Lee, & Chung, 2007, 2008; Flannery, Liederman, Daly, & Schultz, 2000), others have reported gender ratios of approximately 3:1 (Badian, 1999; Beringer, Nielsen, Abbott, Wijsman, & Raskind, 2008; Hoskyn & Swanson, 2000; Katusic et al., 2001; Yoshimasu et al., 2010), 4:1 (Miles et al., 1998), and even 5:1 (Jorm et al., 1986).

A number of factors have contributed to the variability among studies in reported gender ratios. One of the major factors has been a clear lack of agreement in defining poor reading (Siegel & Smythe, 2005), and the terminology used to describe what it means to be a poor reader, whether it be *reading disability, learning disability, specific learning difficulties, dyslexia, low-progress readers*, and so forth. Different definitions of poor reading have subsequently resulted in the development of a considerable number of methods for identifying poor readers. To date the most commonly used methods used are discrepancy formulae, Response-To-Intervention, and low achievement methods. Within these methods, however, variations are also evident in terms severity of selection or the cut-off points for measuring poor reading. Whereas some studies define poor reading as a score of more than 1 Standard Deviation below the mean (Prior, Samson, Smart, & Oberklaid, 1995; Rutter et al., 2004), for example, others employ more stringent cut-offs of 1.5 Standard Deviations (Badian, 1999; Share & Silva, 2003) or even 2 Standard Deviations (Flannery, Liederman, Daly, & Schultz, 2000). Studies have also varied in terms of the actual reading and related skills assessed. Poor reading has been previously defined as poor performance in skills including phonemic awareness, reading comprehension, oral reading fluency, or reading accuracy, rendering it difficult to compare 'poor reading' across studies. Finally, studies vary greatly in terms of samples and methods of sample selection, which can also affect reported gender ratios.

Collectively, differences among these factors have resulted in more confusion than consensus in not only what it means to be a poor reader, but also the degree to which there might be more boys than girls who are poor readers.

Not all researchers essentially agree with the notion that there are actually more boys than girls who are poor readers, however. In recent years a growing body of evidence has demonstrated that, when using empirically-based research based on representative samples, only very small differences between boys and girls are reported (Jiménez, García de la Cadena, Siegel, O'Shanahan, García, & Rodríguez, 2009; Logan & Johnston, 2009; Siegel & Smythe, 2005). Furthermore, even among studies reporting significant gender differences in reading, small effect sizes have been frequently reported (Leppanen et al., 2008; Lohman & Lakkin, 2009; Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). Hyde (2005) recently conducted a large meta-analysis of studies reporting gender differences on a range of cognitive and educational variables to examine the degree to which boys and girls differ. On measures of reading, it was found that boys and girls were more alike than different in a range of reading and related skills, with very small effect sizes reported. Hyde concluded that previously reported gender differences were over inflated and not consistent with empirical evidence.

Others have suggested that a greater prevalence of boys identified as poor readers may be a result of sample selection. A number of studies have found that gender ratios for poor reading are significantly higher in referred samples than in population samples (Flannery et al., 2000; Hawke, Wadsworth, Olson, & DeFries, 2007; Liederman, Kantrowitz, & Flannery, 2005), and because many studies employ referred samples, it has therefore been assumed that many more boys have reading problems (Hawke et al.,

2007; Liederman et al., 2005; Shaywitz et al., 1990; Smart, Prior, Sanson, & Oberklaid, 2001).

It is also possible that gender ratios have been artificially inflated by the actual methods employed to identify poor readers. The discrepancy method, defined as a discrepancy between observed reading performance and reading performance expected based on a child's age and intellectual ability (Fletcher et al., 1994; Share & Silva, 2003), is one of the most frequently used methods of identification. As indicated by Share and Silva (2005), however, this method can result in systematic errors in predicted reading achievement, particularly when pooled data is used: boys can be over-estimated in the bottom of the distribution whereas girls can be over-estimated in the top of the distribution. Others have also found that systematic error can over-estimate the proportion of boys identified (Kranzler, Miller, & Jordan, 1999). Conversely, methods of low achievement, although not as frequently used as discrepancy methods, are not subject to this type of error.

Even when using methods of low achievement, however, it is possible that more boys are identified as poor readers because the distribution of raw scores for reading is not identical for boys and girls. Recent studies have demonstrated that boys have greater variability in scores than girls, and as a result, more boys score in the very tail of the distribution (Hawke et al., 2009; Lynn & Mikk, 2009; Machin & Pekkarinen, 2008). Consequently, more boys will be identified as poor readers. Few studies to date, however, have examined the effect of the variability of scores, but there are considerable implications for differences in reported gender ratios. For instance, if boys have greater

variability in scores, then different severities of selection will yield different gender ratios for poor reading.

At the commencement of this research program, there was a lack of coherent research examining gender ratios for poor reading when controlling for variations in the definition and measurement of poor reading, the effect of diverse severities of selection, the degree to which the variability of boys' scores influenced reported gender ratios, sample selection, and whether gender ratios for poor reading vary with different reading and related skills. Previous research had not comprehensively ascertained whether reported gender differences among studies were a result of these different methodological factors, thereby artificially inflating the prevalence of boys who were poor readers, or whether there were genuine differences between boys and girls. The purpose of this research was to establish, based on empirical data and methods of identification not subject to systematic bias, whether there really are more boys than girls who are poor readers.

This research had the potential to contribute significantly to the existing body of literature. As there are currently very different conclusions regarding boys' reading reported, there are consequently very different conclusions regarding remediation and instruction for boys emerging. As already indicated, a number of inquiries have been conducted, and subsequently funds allocated, for the development of boys' reading programs in an attempt to reduce the reported gender gap. The success of many of these programs, however, remains uncertain, given that not all are empirically-based, employ unbiased samples, or even address critical skills needed for reading. There is controversy as to whether boys even require separate forms of reading instruction. Clarifying the factors that perplex reported gender differences, and attempting to bring closure to the

debate as to whether poor reading is largely a male phenomenon, will have enormous implications for future inquiries into reading for both boys and girls.

Aims of the Research

The broad aims of the research were:

1. To examine the methodological differences across existing studies reporting gender ratios for poor reading, and to investigate the efficacy of proposed explanations to account for reported gender differences.

2. To examine whether there is really a difference in the ratio of boys and girls with reading disability, or whether girls just have superior reading skills more generally.

3. To investigate whether there are specific aspects of reading with which boys struggle more than girls.

4. To establish whether boys demonstrate greater variability in reading scores than girls, and if so, is this is evident across a range of reading and related skills.

5. To examine whether gender ratios of reading disability vary with age.

6. If it is determined that there are really more boys than girls with reading disability, to establish whether gender is helpful in terms of what is offered by way of remediation (i.e. if boys need qualitatively different teaching from girls in order to learn to read).

The objective of this thesis is to determine whether there are really more boys than girls who are poor readers, premised on empirically sound research. As indicated by Smart et al. (2001), a number of factors such as the overuse of referred samples throughout the literature have facilitated the conception that poor reading is largely a male phenomenon. Because referral is often based on subjective methods of

identification, it is possible that not only are many more boys than girls referred, but many girls who are also poor readers remain unidentified (Bauermeister et al., 2007; Biederman et al., 2005) and therefore do not receive the assistance they require. It is of paramount importance that the relationship between gender and poor reading is clearly established, and appropriate methods of identification employed, so that *all* students, irrespective of gender, are identified.

Structure of the Thesis

The research contained in this thesis is presented in a series of published and unpublished research articles in journal style. Each article is self-contained and addresses a particular area of research relating to the overall purpose of the research. These articles are presented with an introduction, conclusion and linking pages between each paper. The publication status of each research article is indicated at the beginning of the relevant chapter. There is some repetition of information as a result of each chapter being self-contained. There is also some inconsistency in style and layout among the Chapters as a result of publication in different academic journals.

Chapter Outlines

Chapter 2

Chapter 2 is a literature review previously published in the *Australian Journal of Learning Difficulties* but substantially rewritten to include more recent literature as well as new areas of research not initially examined (Limbrick, Wheldall, & Madelaine, 2011a). Extensive research over the past two decades indicates that there are more boys than girls diagnosed with reading disability (Liederman, Kantrowitz, & Flannery, 2005), but there is controversy regarding the degree to which there might be more boys than

girls who are poor readers. A number of factors have contributed to the variability in reported gender ratios, most of which stem from a clear lack of agreement in defining and measuring reading disability. Prior to this article the need for consensus in defining reading disability had been identified, particularly with regard to establishing gender ratios for poor reading, but an in-depth examination of all the major factors that impede gender ratios for poor reading had not been provided.

In this paper, the first in-depth examination of the major factors affecting reported gender ratios for poor reading was provided. The paper reviewed the most prevalent research relating to defining and measuring reading disability, with particular emphasis on studies that had been published within the past decade. Studies were also included if gender ratios for reading disability/poor reading had been reported, or where gender ratios could be calculated. The paper examined the most common definitions of reading disability (discrepancy formulae, Response-To-Intervention, and low achievement methods), and how these definitions translate into different methods of identification. It was found that gender ratios fluctuate among, and even within, different methods. Gender ratios were also affected by other factors such as variations in reading assessments (and therefore reading skills measured), severity of selection (cut-off points for defining poor reading), sample selection (random versus referred samples) and the variability of boys' scores. Given the large variations among studies, particularly in actually defining poor reading, estimating the true prevalence of boys and girls who are poor readers has become a complex undertaking, and future methods of identification will need to address these factors. Based on the findings in this review it was concluded

that there may be more boys than girls who are poor readers, but the degree to which there is a greater proportion of boys remains uncertain.

Chapter 3

Chapter 3 consists of a literature review published in *The Australasian Journal of Special Education* (Limbrick, Wheldall, & Madelaine, 2011b). As indicated in Chapter 2, there is not currently an agreed-upon definition of what it means to be a poor reader, and consequently different researchers have approached the issue of poor reading with very different theoretical viewpoints. Likewise, very different explanations as to why there are reportedly more boys than girls who are poor readers have also been proposed. This review examines the empirical evidence supporting the most common explanations for reported gender differences in poor reading, including gender differences in phonemic awareness, auditory processing, problem behaviour, neurology, variability in cognitive ability, and reading motivation.

This article examined each explanation by reviewing research previously published in refereed academic journals within the past decade (with the exception of some earlier studies extensively cited throughout the literature). Each of the above explanations was discussed in a separate section, which commenced with a brief summary followed by a discussion of the available evidence. It was concluded that, although these explanations account, in part, for reading success generally, none could adequately account for reported gender differences in reading. Across all explanations, effect sizes for reported gender differences were consistently small. At the time of this article, an in-depth examination of these six explanations had not been provided. This is the first article to investigate the empirical evidence supporting these explanations to account for reported

gender differences in poor reading. Contrary to a large body of existing research, gender was not found to be a strong or consistent predictor of reading outcomes.

Chapter 4

Chapter 4 is a research article published in the *Journal of Learning Disabilities* (Wheldall & Limbrick, 2010). As indicated in Chapter 3, gender does not appear to be a strong or consistent predictor of reading achievement; however, controversy remains in the absence of an agreed-upon definition and measure of poor reading. One possible approach to defining and measuring poor reading, and consequently estimating the proportion of boys and girls who are identified as poor readers, may be to examine student performance on a large-scale assessment. Large-scale assessments are typically norm-referenced, objective and have high reliability (Sloane & Kelly, 2003), and provide the opportunity to assess a population sample on a single measure of reading (typically reading comprehension), as well as applying a standard severity of selection criteria for defining poor reading. At the time of this study, some researchers had previously reported gender differences by performance on large-scale assessments generally (Baer, Baldi, Ayotte, & Green, 2007; Lynn & Mikk, 2009; Machin & Pekkarinen, 2008; Salahu-Din, Persky, & Miller, 2008), but had not reported gender ratios for poor reading.

This study is the first to report gender ratios for poor reading using a large-scale assessment, the New South Wales Basic Skills Test (BST), administered annually to Years 3 and 5 students in New South Wales schools between the years 1997 to 2006. The overall sample comprised approximately one million students. Students achieved a score for Reading on a Band of 1 to 5 (1=lowest, 5=highest) for Year 3, and 1 to 6 (1=lowest, 6=highest) for Year 5. Poor readers were defined by a method of low achievement and,

taking into account research indicating that poor reading is not a distinct or categorical disorder but exists on a continuum (Coltheart & Prior, 2007), two severities of selection were applied: either a score in the lowest BST band (Band 1) or the lowest two Bands combined (Bands 1 and 2). Gender ratios for poor reading varied with severity of selection and year of schooling. Boys demonstrated slightly greater variability in scores, which may have inflated gender ratios for poor reading. It was concluded that when employing a standardised reading assessment and applying a standard severity of selection for a population sample, there are more boys than girls who are poor readers but gender ratios are not as high or inconsistent as previously reported.

Chapter 5

Chapter 5 is a research article published in the *Australian Journal of Education* (Limbrick, Wheldall, & Madelaine, 2010). This article builds on findings in Chapter 4 (Wheldall & Limbrick, 2010) by calculating gender ratios for poor reading Australia-wide. Prior to 2008, each Australian State and Territory administered its own large-scale assessment to measure benchmark literacy and numeracy. In 2008, however, the National Assessment Program – Literacy and Numeracy (NAPLAN) was introduced in Australia, being the first large-scale assessment administered to students in common grades across the entire country. The introduction of the NAPLAN not only provided a single measure of reading to all Australian students in common grades, but also provided the first opportunity to calculate gender ratios for poor reading nationwide. At the time of this article only one previous study had calculated gender ratios for poor reading using a large-scale assessment (Wheldall & Limbrick, 2010); none had been identified which calculated gender ratios for poor reading for the entire country.

This study is the first to calculate gender ratios for poor reading across Australia. Data for this study were derived from the secondary data presented in *2008 National Assessment Program Literacy and Numeracy: Achievement in Reading, Writing, Language Conventions, and Numeracy* (MCEETYA, 2008). Approximately one million students in Years 3, 5, 7 and 9 attending government and non-government schools participated in the NAPLAN in 2008. Gender ratios were calculated for Reading, Writing, Spelling, Grammar and Punctuation, and Numeracy, using the same low achievement method as Wheldall and Limbrick (2010); that is, a score in the lowest Band, or the lowest two Bands combined. Consistent with previous studies, gender ratios were relatively low and varied with severity of selection. Although girls achieved significantly higher reading means than boys, effect sizes for mean differences were very small, indicating that differences between boys and girls were negligible. The gender ratios for poor reading reported in this study were based on a measure of reading comprehension, but did not identify whether boys and girls struggle with different aspects of reading, or whether gender ratios varied with different aspects of reading.

Chapter 6

Chapter 6 is an empirical study accepted for publication in *Special Education Perspectives* (Limbrick, Madelaine, & Wheldall, in press). Although gender ratios for poor reading can be calculated by performance on large-scale assessments such as the BST (Wheldall & Limbrick, 2010) and the NAPLAN (Limbrick, Wheldall, & Madelaine, 2010), one limitation of this method is that students are only assessed every two years. Furthermore, the reading component of large-scale assessments is typically a measure of reading comprehension, providing very little information on whether boys and girls

struggle with different aspects of reading. Of particular interest is the question of whether boys and girls differ in oral reading fluency. Oral reading fluency is thought to be a significant indicator of general reading ability (Good & Kaminski, 2002). Assessments of oral reading fluency are quick and easy to administer, and can also be used to identify poor readers (Wheldall & Madelaine, 2005). At the time of this study, a large body of research had focused on the importance of oral reading fluency generally, but there was limited research examining gender differences in mean scores, and almost no research on whether boys demonstrated greater variability in scores compared to girls. There was also very limited research on whether boys and girls differ in rates of progress (gains) on measures of oral reading fluency.

This was the first study to collectively examine whether boys and girls differ in oral reading fluency means, variability of scores and rates of progress. Approximately 210 students across Years 2 to 5 were assessed at three different points during the school year on two measures of reading fluency: the Wheldall Assessment of Reading Passages (WARP), which measures oral reading fluency; and the TOWRE, which measures fluency of single word reading and pseudoword reading. Analyses of data involved t-tests for differences in means, and F-tests for differences in the variability of scores and differences in rates of progress. Effect sizes were also calculated for differences in means and rates of progress. Boys and girls did not significantly differ on either measure in mean scores, and rates of progress for boys and girls were almost identical. Due to the sample size gender ratios for poor reading based on oral reading fluency could not be calculated. It was found, however, that boys and girls do not significantly differ in oral reading fluency, and make the same gains over time. Only very limited evidence for

boys' greater variability was evident. As very few studies currently exist regarding the variability of reading scores for boys, it remains unclear whether this phenomenon is evident in all aspects of reading, or even varies with other factors such as years of schooling. Overall, it was concluded that assessments of oral reading fluency may be a simple and objective method of identifying poor readers, unbiased by gender.

Chapter 7

Chapter 7 is an empirical study submitted for publication to a peer-reviewed journal (Limbrick, Wheldall, & Madelaine, 2011c). Gender ratios for poor reading have been previously calculated for primary-aged students by performance on large-scale assessments such as the BST and NAPLAN. Gender ratios for poor reading in the early school years (Kindergarten to Year 2), however, is an area of research largely unexplored. Previous studies reporting gender differences in the early school years have typically reported on one or two aspects of reading only; it was unclear, therefore, whether differences across studies have been a result of different reading skills measured, or whether there are genuine differences between boys and girls when all other factors are controlled. Furthermore, although some studies have previously examined the influence of the variability of boys' scores on gender ratios for poor reading (Hawke et al., 2009), none have reported gender ratios for poor performance across a range of reading and related skills in the early school years.

This study was the first to report gender ratios for poor reading across a range of reading and related assessments for students in Years 1 and 2, and determine whether boys and girls differed in various aspects of reading. This study was also among the first to examine whether boys demonstrate greater variability in scores in early schooling. A

sample of 335 students in Years 1 and 2 were administered seven reading and related assessments at two testing points in the school year (February, August) by trained research assistants. Appropriate statistical analyses were applied to the data, including t-tests for differences in means, Levene's Test for Equality of Variances for gender differences in the variability of scores, and analyses of covariance to examine gender differences in rates of progress. Effect sizes for gender differences in means and rates of progress were also calculated. Gender ratios were calculated for poor performance on each of the measures using a method of low achievement, being defined as scoring in the bottom 25% of the distribution. The results indicated that there were no gender differences in means or rates of progress with the exception of Year 2 on the PPVT, a measure of receptive vocabulary. Effect sizes for all measures were very small. Only very limited evidence was found for boys' greater variability in scores across reading skills, and this did not appear to affect gender ratios for poor performance. Across all measures, gender ratios were relatively low but did increase with years of schooling. It was concluded that boys and girls in the early school years demonstrate very similar abilities in reading and related skills, and make almost identical progress.

Chapter 8

Chapter 8 is a research article accepted for publication in the *Australian Journal of Learning Difficulties* (Limbrick, Wheldall, & Madelaine, in press). Previous Chapters have examined gender ratios for poor reading for primary-aged students as well as early school students, without intervention. This Chapter extends this research by examining whether boys and girls make similar reading progress with appropriate intervention, or whether boys and girls require different forms of remediation. In recent years a number

of inquiries and investigations have been conducted into the educational outcome of boys, particularly the reported gender gap in reading. Reading programs and interventions have subsequently been developed to reduce the gender gap and improve boys' reading. Programs have typically been categorical; in other words, based on the explanations for why there are reported gender differences, such as differences in behaviour, motivation, and so forth. Evidence suggests, however, that boys struggling with reading would most benefit from a non-categorical program which is premised on the critical aspects of reading. The MultiLit ('Making Up Lost Time In Literacy') Program is one such program. Very limited research had been conducted on gender differences when using the MultiLit Program, but this was specifically focused on students with disabilities and special needs (Wheldall & Limbrick, 2005). An examination of whether boys and girls made the same progress using MultiLit has not been provided.

This article is the first examination of whether boys and girls struggling with reading make the same progress in reading when administered the MultiLit Program. A sample of 398 students in Years 5 and 6 attended the Exodus Tutorial Centre for approximately 18 weeks (two school terms) between the years 2005 and 2010. Students were assessed pre- and post-intervention on five reading and related measures. Pre- and post-test raw scores were analysed using t-tests. Overall gains were analysed using Analyses of Covariance. Effect sizes were also reported. There were no significant differences between boys and girls on any of the measures in rates of progress. The findings did not support the necessity for gender-based reading programs, but rather demonstrated that boys and girls

alike make the same progress with good instruction; that is, programs that incorporate the critical aspects of reading.

Appendix

The Appendix includes additional statistics and graphs for several of the research articles, which were not published with the articles.

Summary

In this chapter the purpose of the research reported in this thesis has been clearly stated and a concise summary of the literature has been provided, as a background to the research. This literature focuses on gender and reading.

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CHAPTER 2: METHODOLOGICAL FACTORS AFFECTING REPORTED GENDER RATIOS FOR READING DISABILITY

Chapter Overview

This Chapter includes an initial literature review previously published in *Australian Journal of Learning Difficulties* but substantially rewritten to include more recent literature as well as new areas of research not initially examined (Limbrick, Wheldall, & Madelaine, 2011).

To date the available literature on gender ratios for poor reading is extremely conflicting. Whereas gender ratios for poor reading have been reported up to 5:1 (Jorm et al., 1986; Liederman et al., 2005), others have found little or no difference in the proportion of boys and girls identified as struggling readers (Prior et al., 1995; Siegel & Smythe, 2005). These variances in reported gender ratios have largely stemmed from a lack of consensus of defining poor reading and the resultant differences in assessment, severity of selection, and so forth across studies. It remains unclear therefore, just how many more boys than girls are actually poor readers. As evidenced by Shaywitz et al. (1990), and more recently by others (Hawke et al., 2009; Share & Silva, 2003), however, it is possible that a greater proportion of boys may be identified as poor readers as a result of methodological factors (such as severity of selection and sample selection) rather than actual gender differences in reading. It is important to establish this distinction given the increasing attention on reported gender differences in reading performance (Liederman et al., 2005), and that different approaches and pedagogies to improving boys' reading are continually being proposed based on this belief (Littleton, Wood, & Chera, 2006; Moss, 2000; Sokal & Katz, 2008).

The literature review in the following Chapter was conducted to examine in detail the major themes and issues relating to the prevalence of boys identified as poor readers. Articles were included in this review if they had been published in a peer-reviewed academic journal, reported findings of an empirical study, reported gender ratios for reading disability (or reported percentages of students by gender), and were published within the past 15 years. A review of the available evidence confirmed that a lack of consensus in defining and measuring reading disability has been a major contributing factor in reported gender ratios variances throughout the literature. Discrepancies among reported gender ratios have been affected by factors including variations in reading assessments, sample selection, and the distribution of reading scores for boys and girls. It was concluded that there may be more boys than girls identified as having a reading disability, but the degree to which there may be more boys requires further investigation. This paper contributes new knowledge to the field of special education by providing an in-depth discussion on a range of themes and issues affecting reported gender ratios for poor reading and future directions for identification and measurement.

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Methodological factors affecting reported gender ratios for reading disability: Are there really more boys who struggle with reading?

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Abstract

Extensive research over the past decade has indicated that there are more boys than girls who are struggling readers, but the degree to which there are more boys remains a point of contention. The focus of this article is to review the various definitions of reading disability, to examine how these different definitions translate into different methods of identifying reading disability, and to determine the effects on observed gender ratios for reading disability. The most frequently used methods of identifying reading disability are discrepancy formulae, Response-To-Intervention (RTI), and low achievement methods. Gender ratios clearly fluctuate among, and even within, these methods. Inconsistencies in reported gender ratios of reading disability are a result of inconsistencies in the definition and measurement of reading disability, sampling issues, and the overall distributions of reading scores for boys and girls. Future research might consider reporting gender ratios for reading disability based on consistent measures of reading performance in population samples, using consistent cut off points, over a significant period of time.

Methodological Factors Affecting Reported Gender Ratios for Reading Disability: Are There Really More Boys who Struggle with Reading?

Throughout the literature it appears to be commonly accepted that the majority of children with a reading disability are boys. A plethora of research over the past 15 years attests that boys are more likely to have a reading disability than girls (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Chan, Ho, Tsang, Lee, & Chung, 2008; Coutinho & Oswald, 2005; Flannery, Liederman, Daly, & Schultz, 2000; Katusic, Colligan, Barbaresi, Schaid, & Jacobsen, 2001; Liederman, Kantrowitz, & Flannery, 2005); in some instances, reported gender ratios have reached 6.78:1 (Liederman et al., 2005). Others, however, suggest that there are in fact little or no gender differences in reading disability, reporting gender ratios of approximately 1:1 (Dirks, Spyer, van Lieshout, & Somerville, 2008; Landerl & Moll, 2010). Clearly, the degree to which there might be more boys than girls with a reading disability varies enormously across studies which, not surprisingly, makes it a contentious issue. With such a huge variance in reported gender ratios for reading disability, though, how do researchers conclude which is most accurate? More importantly, given that some studies have reported gender ratios of approximately 1:1, is it possible that there are *not* more boys than girls with a reading disability, but rather many girls remain undetected?

Identifying whether there are more boys than girls who struggle with reading is a complex undertaking, particularly when there are a number of methodological factors to consider, which differ widely across studies (Hawke, Wadsworth, Olson, & DeFries, 2006). As will be discussed, one of the major factors contributing to large variances in reported gender ratios is a lack of consensus in actually defining what it means to have a reading

disability (Siegel & Smythe, 2005). Reading disability has been defined in numerous ways throughout the literature, and has often depended on the approach taken by the individual researcher. For instance, while some researchers advocate that reading disability stems from neurological differences (Wirth et al., 2007) or visual deficits (Bednarek, Saldana, & García, 2009), others have thought it to be a cognitive processing issue (Nelson & Teeter Ellison, 2009). Others have also approached reading disability from a behavioural (Bennett, Brown, Boyle, Racine, & Offord, 2003, Trzesniewski et al., 2006) or motivational point of view (Mucherah & Yoder, 2008).

A lack of consensus in defining what it means to have a reading disability has implications for measuring reading disability. In recent years, the most common methods for identifying reading disability have been discrepancy methods, low achievement methods and Response-To-Intervention methods, however, the assessments employed within these methods vary considerably depending on whether reading disability is viewed from a neurological perspective, or language perspective, or behavioural perspective, and so forth. Differences in defining and measuring reading disability have consequently contributed to a lack of agreement regarding gender ratios for reading disability. Despite this, however, it is nevertheless still commonly believed that more boys than girls have a reading disability. This raises the question of how researchers can say with any certainty that there are more boys than girls with a reading disability, when 'reading disability' itself has yet to be consistently defined and measured?

The purpose of this article is to examine the degree to which differences in methodological factors across studies have impacted reported gender ratios, and determine whether there really are more boys than girls with a reading disability as commonly

thought. An in-depth examination of gauging accurate gender ratios for reading disability therefore begins with the issues surrounding the definition of reading disability, and subsequently the many different ways it has been defined and measured to date. The impact of other factors, such as severity of selection (cut-off points), distribution of reading scores, and sample selection will also be discussed.

Articles were included in this review if they met specific inclusion criteria, namely: (a) were published in a refereed academic journal; (b) reported findings of an empirical study; (c) reported gender ratios of reading disability (or gender ratios could be calculated based on reported percentages of students with reading disability by gender); and (d) were published in the past 15 years, although some important earlier research will be included. The study by Shaywitz, Shaywitz, Fletcher, and Escobar (1990), for instance, has been widely cited in research over the past 15 years and has proved highly influential in the debate surrounding the prevalence of boys diagnosed with reading disability. In searching for relevant articles, the key descriptors used were: 'boy(s)', 'gender', 'reading', 'disability', 'reading difficulty', 'dyslexia', 'poor reading', 'low progress reading', 'bias', and 'ratio'. These descriptors were used in mixed combinations on several educational and psychological online databases including Informaworld, ERIC, Expanded Academic and PsychInfo. Additional searches were conducted in Google Scholar.

Although some researchers have identified the need for consensus in defining reading disability, and its impact on reported gender ratios, there remains a gap in the literature when it comes to an in-depth examination of these issues that impede the degree to which there might be more boys who struggle with reading. This paper therefore attempts to address this gap in the literature. Gauging accurate gender ratios for reading disability has

enormous implications for future research and remediation. First, if it is concluded that there are more boys than girls who struggle with reading, then it is possible that different instruction and/or remediation might benefit boys. Second, if it is found that there are approximately even numbers of boys and girls struggling with reading, but girls have remain undetected, then it is imperative to ensure that methods of identification are appropriately identifying *all* students.

Defining Reading Disability

Determining gender ratios for reading disability can often depend on the actual definition of reading disability employed (Siegel & Smythe, 2005), particularly when the definition invariably determines the method used to diagnose it. In recent years, researchers have considered reading disability as being, among other things, a neurodevelopmental disorder (Liederman et al., 2005; Wirth et al., 2007), a visual deficit (Bednarek, Saldana, & García, 2009), a language disorder (Chan, Ho, Tsang, Lee, & Chung, 2007; Catts, Fey, Zhang, & Tomblin, 1999), and an unexpected under-achievement in reading (Fletcher, Denton, & Francis, 2005). Starting from different theoretical foundations, researchers often classify children whose reading is substantially poorer than other children of the same age using different terminologies that complement their viewpoint, whether it be *reading disability*, *learning disability, specific learning difficulties, dyslexia, poor readers, low achievement*, *low progress readers,* and so forth. Often, these terms overlap and are interchangeable (Coltheart & Prior, 2007) leading to more confusion than consensus in what it means to have a reading disability.

Perhaps the most frequent term used in this area of research is *reading disability*, or *learning disability*. In many studies, reading disability has been commonly defined as a

significant discrepancy between reading achievement and intellectual ability (Chan, Ho, Tsang, Lee, & Chung, 2008; Fletcher, Francis, Rourke, Shaywitz, & Shaywitz, 1992; Liederman et al., 2005; Share & Silva, 2003), known as the discrepancy definition of reading disability. In other words, there is a discrepancy between observed reading performance and reading performance expected based on a child's age and intellectual ability (Fletcher et al., 1994; Share & Silva, 2003). The key characteristic of this definition is the presence of unexpected under-achievement (MacMillan, Gresham, & Bocian, 1998).

The notion of discrepancy between reading achievement and intellectual ability, or unexpected underachievement, however, is not exclusively limited to the term *reading disability*. Across studies it is not uncommon for the terminology to differ even though the actual definition, or formula, remains similar. Miles et al. (1998), for instance, used the description of "poor reading in relation to intelligence" (p. 32) to define *specific developmental dyslexia*. Miles et al. suggested, however, that this definition was not based on a completely accurate assumption, and subsequently amended the definition to attach more importance to weaknesses in spelling rather than weaknesses in reading, as more commonly advocated (Miles et al., 1998). While the amendment in the definition is subtle, it perhaps illustrates the fluidity with which reading disability, and subsequently the prevalence of boys identified as reading disabled, has been viewed over the years.

Miles et al.'s (1998) definition of "poor reading in relation to intelligence" (p. 32) encapsulates, to a degree, some of the less stringent terms used to describe *reading disability*, such as *low achievement, learning difficulty,* and *reading difficulty*. Typically, these definitions often describe a delay in reading anywhere between 6 months and 2 years (Prior et al., 1995) (or an achievement score below a set criteria), and frequently specify an

intelligence test score in the average range (Katusic et al., 2001). Hoskyn and Swanson (2000), for example, reviewed studies on the cognitive processing of low achievers compared to children with reading disabilities, and defined low achievers as scoring below the 40th percentile on a standardised reading test, as well as verbal intelligence test scores between 70 and 96. More recently Berninger, Nielsen, Abbot, Wijsman, and Raskind (2008) specified that participants have a score of at least 90 on a prorated WISC-3 Verbal IQ, and an achievement score of at least 1 Standard Deviation below the population mean on a normed measure of oral reading fluency. Conversely, though, many definitions of poor reading and low achievement do *not* specify the inclusion of an intelligence test score criterion, but are based solely on reading test performance. Siegel and Smythe (2005), for instance, specified low performance on measures of fluency and accuracy, while Prior et al. (1995) defined reading disability as more than one standard deviation below the mean on a word knowledge test. Rutter et al. (2004) defined reading disability as reading scores in the lowest 15% of the distribution. Locascio, Mahone, Eason, and Cutting (2010), on the other hand, defined a word recognition deficit as a score at or below the 25th percentile on a test of word recognition.

Similar to *reading disability*, the term *dyslexia* has also been used to encompass a delay in learning to read, particularly when intelligence is in the average range and there are no emotional or sensory impediments (Prior et al., 1995). In a large study in Hong Kong, Chan et al. (2007) defined dyslexia as "conceptualized as the unexpected yet marked difficulties in reading, writing and spelling in children who are otherwise healthy, well-nurtured, earnest and cognitively advanced" (p.249). Although the term *dyslexia* often shares many features incorporated in a number of the definitions *reading disability* and *learning*

disability, it is by no means limited to discrepancies between reading achievement and intellectual (or cognitive) ability. Other researchers attest that *reading disability*, or *dyslexia*, has a neurological basis which becomes evident in reading and writing difficulties. Siegel and Smythe (2005) argued that reading disability should be defined as difficulties in acquiring the necessary accuracy and fluency skills needed for reading. Others have also identified the importance of language abilities, particularly phonological processing, in reading achievement (Bednarek et al., 2009; Catts et al., 1999; de Jong & van der Leij, 2002; Linklater, O'Connor, & Palardy, 2009; Sofie & Riccio, 2002). A working definition proposed by Lyon, Shaywitz, and Shaywitz (2003) defines *dyslexia* as:

"a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge." (p.2)

Other researchers argue that *reading disability*, or *dyslexia*, cannot be defined by specific inclusions or exclusions of definitions, but rather, is continuous in nature and varies only by degree of severity (Kiuru et al., 2011; Siegel & Smythe, 2005; Sofie & Riccio, 2002). Stanovich (1999), in a critique of the concept of learning disability, observed that reading disability is not a distinct condition; there is no single point where one either

has, or does not have, a reading disability. He claimed, as an example, that there are no psychometric or cognitive differences between individuals who are at the 13th percentile cutoff or at the 18th percentile cutoff for reading. More recently, Siegel and Smythe (2005) proposed that there is "no readily accepted cutoff score below which an individual can be considered to have RD" (p.474). In a key Policy Paper issued by the Academy of Social Sciences in Australia, Coltheart and Prior (2007) stated:

"There is no way of making any qualitative distinction between 'children with dyslexia' and 'children without dyslexia'; the distinction is purely quantitative (ie, depends on how far behind in reading a child is required to be before he warrants the label dyslexia) and therefore arbitrary. This is because reading is a skill that is distributed continuously rather than dichotomously across any group of children." (p.1)

According to Coltheart and Prior (2007), *poor reading* or *reading disability* is not defined by numbers or percentile rankings, but rather the *degree* to which a child lags in comparison to their peers. There appears to be an ongoing debate, however, as to what degree, or percentage of students in the tail of the distribution, might be classified as reading disabled, and ultimately the extent to which there are more boys than girls who struggle with reading. A recent study by Aaron, Joshi, Gooden, and Bentum (2008), for example, identified up to 38% of American students in Grade 4 as reading below the basic reading level. In Australia, it is believed that up to 20% of students struggle to learn to read, while approximately 10% of those will have substantial reading difficulties (Coltheart & Prior, 2007). Others have observed an incidence of reading disability of up to 11%

(Katusic et al., 2001) or 12% (Kiuru et al., 2011). Prior et al. (1995) estimated that reading disability varied from 5% to 15% of the population depending on the study, whereas others claim that only a small subset of the population (4-6%) is reading disabled (Sofie & Riccio, 2002). It is not surprising, then, that the number of students diagnosed as reading disabled remains a point of contention.

There is also evidence to suggest that boys are more likely to have more severe degrees of reading disability than girls, and thus higher gender ratios are more likely to be observed when the percentage of students is smaller (i.e. the very tip of the distribution tail) (Flannery, Liederman, Daly, & Schultz, 2000; Share & Silva, 2003; Stevenson, 1992). The greater the severity of selection, or cut-off point, for defining reading disability, the greater the number of boys identified (Hawke et al., 2009; Machin & Pekkarinen, 2008). Stevenson (1992), for example, reported higher gender ratios for a severity of selection of 2 Standard Deviations below the mean (2.5:1), compared to 1 Standard Deviation (1.64:1). Limbrick, Wheldall and Madelaine (2010) reported a gender ratio of 1.82:1 for the bottom 6% of the distribution, compared to 1.6:1 for the bottom 18%, for Year 3 students. In their study Limbrick et al. also reported similar trends for Years 5, 7 and 9 students. Gender ratios, therefore, can fluctuate depending on the percentage of students, or severity of selection, when defining reading disability.

It should also be acknowledged that *reading disability*, or *poor reading*, can sometimes be a result of other factors beyond difficulties in language and phonological processing. For instance, research has long suggested that socio-economic factors can have a significant impact on academic achievement (Entwisle, Alexander, & Olson, 2007; Chiu & McBride-Chang, 2006), and can increase the likelihood of the identification of learning disability

(Coutinho, Oswald, & Best, 2002). Studies have shown that socio-economic factors can account for up to 24% of variance in reading ability (Fluss et al., 2009).

The conclusion is clear: definitions of reading disability in recent years have often overlapped and been used interchangeably, regardless of whether the same skills, or significantly different skills, are being measured. It is not surprising, then, that one of the greatest barriers in understanding the nature of reading disability has been a failure to agree on a workable definition of reading disability (Stanovich, 1999). A lack of understanding as to the continuous, rather than dichotomous, nature of the disorder has hindered progress in the field (Siegel & Smythe, 2005). So, too, has the variability in the percentage of students who might reasonably be considered reading disabled, where different severities of selection can affect reported gender ratios. There are far reaching implications for these unresolved issues: to what degree do different definitions of reading disability and different methods of diagnosis affect reported gender ratios?

Measuring Reading Disability

Reading disability has previously been defined in a number of ways, which has enormous implications for the way in which reading disability is measured. Indeed, the variations in methods used for the identification of children with reading disabilities have long been a topic of debate, not least in identifying the prevalence of boys who struggle to read. Table 1 summarises recent studies that have reported gender ratios for reading disability, including the methods used to diagnose reading disability and sample sizes. Studies have also been reported if gender ratios for reading disability can be calculated from the data presented in the study. The most commonly used methods of identification for reading disability are discrepancy formulae, Response-To-Intervention (RTI), and low

achievement methods. As will be discussed, variations are evident not only among methods for identifying reading disability, but also within methods. This has subsequently led to variations in the reported gender ratios for reading disability (see Appendix 1).

Discrepancy Formulae. The definition of reading disability has commonly been operationalised by means of discrepancy formulae (MacMillan et al., 1998), and is thus has often been used to generate gender ratios for reading disability. The basic definition of the discrepancy formula is outlined in the *Diagnostic and Statistical Manual of Mental Disorders (4th edition)* (DSM-IV; American Psychiatric Association, 1994):

"Reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the person's chronological age, measured intelligence, and age-appropriate education" (p.50).

A significant number of studies over the past decade have measured reading disability by using discrepancy formulae (see, for example, Fletcher et al., 1992; Liederman et al., 2005; Share & Silva, 2003). Even among studies employing discrepancy formulae, however, there remain sizeable inconsistencies in the prevalence of boys with reading disabilities (see Table 1). Although the basic discrepancy formula is seemingly straightforward, inconsistencies in the selection and application of intelligence tests, reading tests, cutoff points for discrepancy (for example, 1 standard deviation versus 2 standard deviations), and computation have resulted in inconsistencies of reported gender ratios (Fuchs, Mock, Morgan, & Young, 2003).

In four independent studies, Rutter et al. (2004) reported gender ratios of reading disability based on a discrepancy of more than 1 standard deviation between observed reading scores on the Burt Word Reading Test, and reading scores predicted from the WISC-R Performance IQ score. Across the four studies they reported gender ratios of 3.29:1 (Dunedin, New Zealand), 2.76:1 (Christchurch, New Zealand), 1.74:1 (Office for National Statistics Study, UK), and 1.93:1 (Environmental Risk Longitudinal Twin Study, UK) (see Table 1). A study by Yoshimasu et al. (2010) classified participants has having a reading disability using a regression formula, a discrepancy formula and a low achievement formula (see Table 1 for details). Students were classified as having a reading disability if they met the criteria for any of the three formulae. Gender ratios were not calculated by method of identification, however; instead, they were calculated depending on whether participants also presented with a reading disability and ADHD (ratio 3.19:1) or reading disability only (1.89:1). Chan et al. (2008) reported varying gender ratios depending on the formula used: 2.05:1 (Hong Kong Cognitive Marker measure), 2.19:1 (discrepancy formula) and 2.26:1 (regression formula). Other studies have applied yet other variations of discrepancy formulae and reported gender ratios of 1.88:1 and 2.33:1 (Flannery et al., 2000); 2.72:1, 2.85:1 and 2.98:1 (Katusic et al., 2001); 1.22:1 and 3.76:1 (Willcutt & Pennington, 2000); approximately 1.43:1 (Pereira-Laird, Deane, & Bunnell, 1999); and 3.2:1 (Badian, 1999) (see Table 1).

There is also evidence to suggest that even subtle differences in discrepancy formulae can have an impact on reported gender ratios. As different formulae use different cut-off points (or severity of selection), different gender ratios are subsequently generated. For instance, Flannery et al. (2000) reported larger gender ratios using a severe definition of

reading disability (>2 Standard Deviations) compared to a moderate definition (>1.5 Standard Deviations).

Additionally, as mentioned earlier, Miles et al. (1998) made a small amendment to a commonly used definition of reading disability. A gender ratio of 4.51:1 was reported, one of the largest gender ratios of reading disability reported in this review (see Table 1). This calls into question whether an unmodified definition of reading disability would have yielded similar results, or whether the prevalence of boys is actually greater than is commonly reported.

The degree to which there are more boys than girls with reading disability, then, clearly fluctuates according to the discrepancy definitions of reading disability employed, particularly in light of the many possible combinations of intelligence and reading tests used in discrepancy formulae, and the discrepancies used for diagnosis.

Despite the prevalence of discrepancy formula in the literature, several researchers have raised concerns about the validity of this method. Aside from inconsistencies in reported gender ratios between studies, Fuchs et al. (2003) observed that the IQ-achievement discrepancy model fails to recognise many struggling readers: children with lower IQ scores who remain unidentified because there is not a significant discrepancy apparent. If discrepancy formulae do not identify students who are truly struggling to read (or in fact falsely identify students with high IQs who are *not* struggling to read), this would clearly affect the reported gender ratios for reading disability.

Fuchs et al. (2003) also argue that the discrepancy model is a "wait-to-fail" model, where students struggle for years before their achievement scores are significantly low enough to produce a discrepancy (p.158). More recently, however, some researchers have

proposed that the discrepancy method is an illogical approach to diagnose reading disability, because it does not measure the acquisition of fluency and accuracy, which are skills required for reading (O'Malley, Francis, Foorman, Fletcher, & Swank, 2002; Siegel & Smythe, 2005; Stanovich, 1999). For this reason, gender ratios of reading disability generated by the discrepancy approach are beginning to be viewed with caution (Fuchs et al., 2003; Fletcher et al., 2005; Siegel & Smythe, 2005; Sofie & Riccio, 2002).

More recent evidence suggests that gender bias is possible using discrepancy formulae based on IQ than other methods of identification (Jimenéz, García de la Cadena, Siegel, O'Shanahan, García, & Rodríguez, in press). Share and Silva (2003) found that when using discrepancy formulae girls' scores were underestimated and boys' were overestimated, based on a combined mean for both boys and girls. Gender ratio for reading disability was 1.79:1 when using a combined regression. When calculated separately for boys and girls, gender ratios were reduced to approximately 1.02:1. Stevenson (1992) reported similar findings.

Response-To-Intervention. In recent years, the diagnostic concerns of discrepancy formulae have led researchers to consider alternative methods of identifying reading disability. Several alternative methods of reading disability identification have been proposed, the most notable of which is the Response-To-Intervention (RTI) model. RTI is a multitiered approach to identification and instruction (Fuchs, Compton, Fuchs, Bryant, & Davis, 2008). The number of stages (or tiers) varies between models (Fuchs & Fuchs, 2006), but the basic model comprises three distinct stages (Fuchs et al., 2003). Tier 1 is premised on the belief that all students receive effective reading instruction in the classroom, predicated on evidence-based best practice as identified by scientific research.

Class-wide reading progress is monitored, and students who do not respond to this level of effective instruction are then offered Tier 2 support (usually small group instruction, again based on best practice). Approximately 25% of students reach Tier 2. Progress in Tier 2 is also continually monitored, and if students do not adequately respond to Tier 2 intervention, they are then referred to Tier 3 (usually individualised instruction) (Barnett, VanDerHeyden, & Witt, 2007). This third Tier is for the smaller percentage of students who still do not respond to instruction received at Tier 1 and Tier 2. The advantage of RTI over other methods of identification is that it provides repeated curriculum-based assessments over time, rather than assessment at a single point in time (Fletcher et al., 2005). Additionally, RTI models promote early intervention as opposed to the discrepancy method's "wait-to-fail" approach (Fuchs et al., 2003).

The goal of RTI is to provide early intervention, to match teaching to the needs of students, and to monitor progress (Vaughn, Linan-Thompson, & Hickman, 2003). RTI, however, may be prone to the same disadvantages as discrepancy approaches, in that it has been implemented in different ways, using different forms of remedial, intensive instruction (Fuchs et al., 2003). There is significant variation across studies in the number of RTI stages (anywhere between 2 and 4), the type of remedial programs administered, the program duration (varying between 8 and 12 weeks), and the degree of academic progress required to exit the program (Fuchs & Fuchs, 2006). Not surprisingly, variations among RTI models affect the gender ratios of students identified as reading disabled.

Vaughn et al. (2003) proposed a two-tier model of RTI and identified 45 students in Year 2, who were at-risk of reading failure. Students were nominated by teachers, and received 10 weeks of daily supplemental reading instruction. At the end of 10 weeks, if

students did not meet the exit criteria (for example, made significant progress), they were given a further 10 weeks' instruction. If students still did not respond to supplemental instruction, they continued in the program. Vaughn et al. found that pretest scores on fluency, comprehension and rapid naming significantly predicted students who were non-responders to intervention. There were 25 girls and 20 boys who entered the program, who exited at various points (for example, after 10 weeks, 20 weeks or 30 weeks instruction). After 30 weeks (no exit), there were four boys and seven girls who were still not adequately responding to instruction. It is interesting to note that these findings indicate boys are *not* at greater risk for reading disability than girls.

A study by VanDerHeyden, Witt, and Gilbertson (2007), on the other hand, employed a four-tier RTI model, where initial assessment (Tier 1) was conducted using the System to Enhance Educational Performance (STEEP) program, a set of curriculum-based measures in reading and mathematics to ascertain the student's level of performance compared to their peers in the classroom. The findings were based on the implementation of STEEP at five schools in the Vail School District in Arizona, between 2002 and 2005. Using STEEP, the gender ratio of students identified as struggling to read was 1.35:1 (see Table 1).

For all its growing support, concerns have been raised as to the efficacy of RTI. In the first instance, RTI is predicated on the assumption that students in Tier 1 have received exemplary, evidence-based reading instruction. In other words, they have been taught correctly in the first place. Some researchers, however, have questioned the effectiveness of reading instruction provided in schools (Spencer, 2000). In a paper by Coltheart and Prior (2007), it was observed that Australian trainee teachers spent only between 5% and 10% of course time preparing to teach reading. If this is the case, how can exemplary, evidence-

based reading instruction at Tier 1 be guaranteed? The issue has yet to be resolved. In the meantime, the degree to which there may be more boys than girls identified as reading disabled by RTI methods, like discrepancy approaches, remains uncertain. It should be acknowledged, though, that RTI is a relatively new approach and there are few studies to date regarding gender ratios based on RTI.

Low Achievement Models. Methods based simply on low achievement have also been advocated to identify the relative prevalence of boys who are struggling to read. An Australian study by Prior et al. (1995) reported non-significant gender differences based on reading performance on the Australian Council for Educational Research (ACER) Word Knowledge Test (ACER, 1969). Students were identified as reading disabled if they scored more than 1 standard deviation below the mean (see Table 1). Siegel and Smythe (2005) analysed data from a longitudinal study of Canadian students from Kindergarten to Grade 5. They applied the Woodcock-Johnson subtests of Word and Letter Identification and Word Attack, using 1 and 2 standard deviations below the mean to identify the severity of reading disability. Siegel and Smythe (2005) reported non-significant gender ratios for Grades 1 to 5 (see Table 1). Rutter et al. (2004), however, specified reading disability as reading scores in the lowest 15% of the distribution and reported more substantial gender ratios. Across four independent samples, gender ratios determined by reference to low achievement were 3.19:1 (Dunedin, New Zealand), 2.38:1 (Christchurch, New Zealand), 1.43:1 (Office for National Statistics, UK), and 1.39:1 (Environmental Risk Longitudinal Twin Study, UK) (see Table 1). Locascio, Mahone, Eason, and Cutting (2010) more recently reported that word recognition deficits were defined as a score at or below the 25th percentile on the Basic Skills Cluster of the Woodcock Reading Mastery Test-Revised

(WRMT-R), and reading comprehension deficits as a score at or above 37th percentile on WRMT-R but a score at or below 25th percentile on at least two of five reading comprehension measures. Gender ratios were 1.93:1 and 1:1 respectively. Kiuru et al. (2011) specified a cut-off point of 12% on measures of reading and spelling and reported gender ratios of 2:1.

Like discrepancy and RTI methods, low achievement models are also prone to the same degree of inconsistency in reported rates of reading disability for boys. For example, across different studies using methods of low achievement, there are a wide range of tests and cut off points to diagnose reading disability. Whereas the lowest 12th percentile of a distribution is classified as reading disabled in one study (Kiuru et al., 2011), the lowest 25th percentile is classified as reading disabled in another (Badian, 1999; Locascio et al., 2010). Gender ratios for reading disability vary not only with different methods of assessment, but different cut-off points. As discussed earlier, a number of studies have reported that gender ratios are higher in the very tail of the distribution; in other words, a smaller percentile will yield a greater number of boys identified. This trend appears to be evident across all methods of identification.

Despite the inconsistencies within models of low achievement, differences in the prevalence of boys and girls identified with a reading disability appear to be lower than for discrepancy methods, however (see Table 1).

Other Methods of Identifying Reading Disability

Although the most commonly used methods of identifying reading disability are discrepancy methods, Response-To-Intervention methods and low achievement methods, it should also be noted that the identification of reading disability is not limited to these three

methods. Others, for example, have defined reading disability by student self-reporting measures. In a recent study by Undheim and Sund (2008), participants with a mean age of 13.7 years were identified as having dyslexia if they self-reported difficulties ("Have you had specific reading and writing problems (dyslexia) in the last 12 months?"). Participants who answered 'yes' were then presented with a second question regarding the degree of problems (large problems, some problems, no problems). Participants who responded with 'large' or 'some' problems were included in the RD sample. The gender ratio reported for RD was approximately 1.21:1.

However reading disability is measured, it is clear that the variation in the methods used to diagnose reading disability is a major contributing factor to the variability of reported gender ratios in the literature. Because of the variance among and within methods then, identifying which method of reading disability identification is the most appropriate or accurate should be approached with caution. As has been discussed, there are both advantages and disadvantages to all methods of identification. Despite this, however, there are several reasons why methods of identification that isolate the bottom percentage of students (or the tail of the distribution) are preferable over other methods. First, methods that specify the lowest portion of the distribution tail are complementary to the continuous nature of reading, despite the variance in the proportion of students identified. Second, with discrepancy formulae, there is the risk that students can be falsely identified as reading disabled or dyslexic, particularly if they have a high IQ. This error is unlikely to occur with other methods of reading disability identification. There is also evidence to suggest that discrepancy formulae do not measure the skills needed for reading (Siegel & Smythe, 2005; Stanovich, 1999). Based on these assumptions, then, gender ratios may be more

accurate when attained by methods which define reading disability as scoring in the tail end of the distribution. If this is the case, then gender differences may actually be lower than previously thought: Siegel and Smythe (2005) and Prior et al. (1995) both reported non-significant, or very small, gender differences in reading disability. Rutter et al. (2004) also reported relatively low gender ratios of 1.39:1 (Environmental Risk Longitudinal Twin Study, UK) and 1.43:1 (Office for National Statistics, UK), although it should be noted that they also reported higher gender ratios of 2.38:1 and 3.19:1. These higher ratios, however, were based on New Zealand samples, and the authors acknowledged that New Zealand had the third highest sex difference in literacy levels worldwide. As will be discussed later in the review, differences in samples (population versus clinical) and distributions can also have a significant impact on reported gender ratios.

Identifying students by isolating tails of the distribution, while it has its advantages, should be viewed in conjunction with recently emerging evidence on the distribution of reading scores, particularly for boys.

The Distribution of Reading Scores for Boys and Girls

One of the primary focal points in the literature on reading disability is the fact that boys, to varying degrees, are more often diagnosed as reading disabled than girls. Attention has consistently been focused on the lower end of the distribution for reading performance. The prevalence of males identified as reading disabled, however, may only be a part of a much larger picture. What is often not reported in the literature is the pattern of distribution for boys and girls in the middle and upper end of the distribution. If the bottom of the distribution is predominantly boys, how is the rest of the distribution for boys and girls made up? Are scores for boys and girls spread evenly across the middle and upper part of

the distribution, or do girls predominate at the top end of the distribution to make up for their under-representation in the bottom end?

Flannery et al. (2000) found that although boys were more likely to be diagnosed with mild, moderate or severe reading disability than girls, at the top end of the distribution they also found that girls were more likely to be classified with superior reading performance. They reported a significant preponderance of girls in the three highest levels of the distribution. Prior et al. (1995) reported non-significant differences at the lower end of the distribution, but significant differences in favour of girls at the top end in the region of 1.31:1 (59% girls, 41% boys). Machin and Pekkarinen (2008) analysed student performance on the Programme for International Student Assessment (PISA), a reading and mathematics assessment for 15-year-olds. In 39 out of 41 countries they reported a greater prevalence of boys in the bottom 5% of the distribution, and in 36 out of 41 countries reported more girls in the top 5%. Gender gaps, however, were smaller at the top 5% compared to the bottom 5%.

Despite these findings, some researchers have argued that boys are over-represented in the lower end of the distribution and girls are over-represented in the upper end of the distribution not as a result of actual differences in reading between boys and girls, but rather as a result of systematic predictions using IQ-achievement regression discrepancy formulae. Share and Silva (2003), for example, found that when the distribution of boys and girls is not the same, but performance cut-offs are determined by pooled results (a single distribution for boys and girls), there can be an over identification of boys labelled reading disabled and an over identification of girls with superior reading performance. In their study, they reported that there were 92 boys and 85 girls identified as reading disabled

(in a sample of 914) using separate distributions, however, when using a combined distribution they found there were 118 boys and 62 girls identified as reading disabled. It should be noted, however, that Share and Silva's (2003) results are based on a regression discrepancy approach. Flannery et al. (2000) also used a regression discrepancy formula. Prior et al. (1995), however, reported similar patterns of distribution by simply using a score of more than 1 standard deviation below the mean on the ACER Word Knowledge Test (approximately the bottom 16% of the distribution), which is not subject to systematic over- or under-predictions. Stevenson (1992) compared gender ratios for regression, discrepancy and age only methods, using combined and separate distributions for boys and girls for each of the three methods. In every instance, gender ratios were noticeably lower for separate distributions than for combined ones (see Table 1).

In a similar vein, others have proposed alterative explanations for a greater preponderance of boys in the bottom of the distribution. Emerging evidence suggests that more boys are identified as poor readers because boys tend to have a greater variability in reading scores. Recent studies have found that although boys and girls achieved similar reading means, more boys were identified in the bottom of the distribution because boys had greater variability in their scores. Girls' scores, on the other hand, have been found to cluster more closely around the mean (Hawke et al., 2009; Lynn & Mikk, 2009). This suggests that because boys' scores are distributed more widely, then more boys will score in the bottom of the distribution and be identified as reading disabled. This phenomenon has been demonstrated across a number of countries. As discussed above, Machin and Pekkarinen (2008) reported more boys in the bottom 5% of the distribution on the PISA, however, they also found that across all 41 countries, that boys had greater variance in

reading than girls. They concluded that the greater percentage of boys in the bottom of the distribution was a result of boys' greater variance. Lynn and Mikk (2009) reported similar findings.

The fact that boys have greater variability in reading scores might also account for the fact that gender ratios for reading disability increase with severity of selection. It is possible, then, that there is little difference between boys and girls in mean reading scores, however, differences in variability result in more boys than girls identified as having a reading disability. Although more attention is now being given to the role of variability in scores when examining distribution scores (Priess & Hyde, 2010), more research is clearly needed. It remains unknown, for example, whether boys' variability is affected by age or years of schooling, or whether boys demonstrate greater variability in all reading and reading-related abilities.

Measuring Appropriate Reading Skills

Rates of reading disability, and subsequently gender ratios of reading disability, fall prey to specific inclusion and exclusion criteria, depending on the researchers' interpretation of reading disability, as we have seen. Aside from the differences within and among various methods of identifying reading disability, a key issue to be raised is what is actually being measured across studies. In identifying the prevalence of boys struggling to read, it is important to acknowledge that different reading assessments measure different skills. While some studies may define reading by measures of phonological awareness (Moura, Mezzomo, & Cielo, 2008; Papadopoulos, Spanoudis, & Kendeou, 2009), others define reading by comprehension (Entwisle et al., Locascio et al., 2010; Logan & Johnston, 2009; Wheldall & Limbrick, 2010) or oral reading fluency (Wang, Porfeli, & Algozzine,

2008; Pearce & Gayle, 2008). The question arises, then, of whether gender ratios for reading disability vary according to different reading measures? Among the most common assessment measures of reading performance employed in the studies discussed within this study are the Woodcock Johnson (Woodcock, McGrew, & Mather, 2001), the Wide Range Achievement Tests (WRAT) (Wilkinson, 1993; Robertson, 2001; Wilkinson & Robertson, 2006), the Progressive Achievement Tests (PAT) (Reid & Elley, 1991, 2001) and the Burt Word Reading Test (Thorpe, 1974).

Letter-word identification. Assessments used to measure letter-word identification include the *Woodcock Johnson* and *Wide Range Achievement Tests (WRAT)*. The Woodcock Johnson has frequently been employed in identifying rates of reading disability. The Woodcock Johnson measures, among other things, intellectual ability and academic achievement. In particular, the Letter-Word identification subtest assesses a child's reading skills in identifying isolated letters and words. Using this test, Siegel and Smythe (2005) reported no significant differences between boys and girls, and Shaywitz et al. (1990) likewise found low gender ratios. Conversely, however, Katusic et al. (2001) reported a higher gender ratio of 2.72:1 (see Table 1 for details). The *WRAT* is a brief achievement test measuring reading recognition and spelling. Again, there were variations between studies as to whether more boys than girls struggled with these reading skills. Flannery et al. (2000) reported gender ratios of 1.88:1 and 2.33:1, while Siegel and Smythe (2005) reported non-significant differences. Locascio, Mahone, Eason, & Cutting on WRMT-R was 1.93:1.

Oral Reading Fluency. Oral reading fluency is defined as the capacity to read effortlessly with accuracy and speed (Musti-Rao, Hawkins, & Barkley, 2009). It is

important in learning to read. Interestingly, it is worth noting that at the time of this study, only one study could be found which discussed gender ratios for reading disability by measures of oral reading fluency. Landerl and Moll (2010) recently assessed reading by performance on a standardised sentence reading test which measured oral reading fluency. In the Learning Difficulties sample, the gender ratio was 1.1:1. Few studies, however, actually focus on gender, or even report gender as a variable, for ORF.

As can be seen, gender ratios for reading disability vary depending on which facet of reading is being measured. It should be noted that these gender ratios, while varying with reading measure, also vary with other methodological confounds as previously discussed, including differences among studies in sample size and sample selection, definition of reading disability, and severity of selection for defining reading disability. The impact of the actual reading measure is difficult to ascertain given that few studies to date have administered a wide range of reading assessments to a single population sample. Gender differences in different facets of reading, therefore, remain unclear.

Other Measures of Reading Ability. Other studies have employed the Burt Word Reading Test, similar to the WRAT (Rutter et al., 2004; Share & Silva, 2003), and the Progressive Achievement Tests in Reading Comprehension and Reading Vocabulary (PAT) (Pereira-Laird et al., 1999). Rutter et al. (2004) identified 1.39:1 to 3.29:1 more boys than girls as reading disabled using the Burt Word Recognition Test. Share and Silva (2003) also reported significantly more boys than girls identified as reading disabled using the Burt. Miles et al. (1998), on a single word recognition test, reported a gender ratio of 4.51:1.

Of the studies briefly reviewed above, gender ratios of reading disability are so highly inconsistent among studies, that caution should be exercised when identifying any emerging patterns. For example, on the one hand, there is evidence to suggest that boys struggle, to varying degrees, with word recognition (Flannery et al., 2000), identifying letters and words (Katusic et al., 2001), and reading comprehension (Pereira-Laird et al., 1999). At the same time, however, there is also evidence to suggest that boys do *not* struggle with these skills any more than girls do (Siegel & Smythe, 2005). Because different reading tests have been used in different methods of diagnosis, even when measures of reading are identical, inconsistencies are not just confined to the prevalence of boys struggling with learning to read; inconsistencies are also reported in identifying the specific skills with which boys struggle most.

Sampling Issues

Research has also consistently shown that the prevalence of boys with reading disability is significantly higher in referred, clinical samples than in population samples (Hawke, Olson, Willcut, Wadsworth, & DeFries, 2009; Hawke, Wadsworth, Olson, & DeFries, 2007; Liederman et al., 2005; Nelson & Teeter Ellison, 2009; Shaywitz et al., 1990). Previous studies have indicated that a higher rate of boys identified as reading disabled may be due to referral bias, where boys tend to be over-referred to special education services (Flannery et al., 2000). A ground-breaking longitudinal study by Shaywitz et al. (1990) examined the implications of sample bias on reported gender ratios. They hypothesised that more boys would be diagnosed with reading disability than girls in school-identified methods of referral, compared with research-identified methods. In this study, students were classified as reading disabled by two criteria: either by school-

identified classification, where the school identified students as reading disabled, or they received special education services, or by a research-identified classification, employing a discrepancy formula using the WISC-R Full Scale IQ score and performance on the Woodcock-Johnson Reading Cluster. Results indicated that the prevalence of boys with reading disability was up to four times higher in the school-referred classification compared to the research-identified classification. For Year 2 students, the research-identified gender ratio (based on data reported in the study) was approximately 1.26:1, whereas the school-identified gender ratio was approximately 4.25:1. For Year 3 students, gender ratios were approximately 1.5:1 and 2.38:1 respectively (Shaywitz et al., 1990) (see Table 1). Others have since reported similar findings (Hawke et al., 2007; Share & Silva, 2003).

One of the major factors contributing to the greater prevalence of boys in referred samples is probably classroom behaviour. Boys tend to display more acting out classroom behaviour whereas girls tend to display more passive behaviour (Entwisle, Alexander, & Olson, 2007; Prior et al., 1995). As a consequence, boys are more likely to be identified and diagnosed as poor readers, and subsequently more likely to be referred to special education programs (Nelson & Teeter Ellison, 2009). Referral bias, or ascertainment bias, therefore often inflates the degree to which more boys than girls are identified and diagnosed with a reading disability (Flannery et al., 2000).

Beaman, Wheldall, and Kemp (2007) recently published a review of the literature on troublesome classroom behaviour, and found that at any one time, teachers could be expected to manage between two and nine students with various degrees of troublesome or disruptive behaviour. Boys were consistently more frequently considered difficult to

manage in the classroom (Beaman et al., 2007). It is not surprising, therefore, that troublesome behaviour may be a contributing factor to the higher rates of boys identified by schools as reading disabled. Similarly, Skårbrevik (2002) found that the preponderance of boys identified in school settings as having reading difficulties resulted from a greater proportion of boys displaying disruptive behaviour. This raises the question of whether students display troublesome behaviour because they are struggling with reading, or vice versa.

It is also worth acknowledging that while there is research to suggest that there is a clear link between behaviour and reading, other studies have shown that the gap between boys and girls may increase as a result of teacher response to boys' behaviour, rather than the behaviour itself. Student behaviour is often measured by teacher-rated surveys (Aaron, Joshi, Palmer, Smith, & Kirby, 2002), and it has been demonstrated that teachers often rate boys' behaviour lower than girls' behaviour (Entwisle et al., 2007; Onatsu-Arvilommi & Nurmi, 2009). It is possible, then, that when teachers respond negatively to boys' behaviour, this can result in different reading outcomes over time (Entwisle et al., 2007).

Akin to higher gender ratios in referred samples, research also suggests that co-morbidity with disorders such as ADHD can inflate gender ratios: inattentive behaviours associated with ADHD may hasten more frequent referrals for boys (Willcutt & Pennington, 2000; Yoshimasu et al., 2010). It has been estimated that between 15% and 26% of students with reading disability are also diagnosed with ADHD (Shaywitz et al., 1990). Willcutt and Pennington (2000) found that for their entire sample, the gender ratio of reading disability was 1.22:1. The gender ratio was significantly higher at 3.76:1, however, for students presenting with both a reading disability and ADHD. More recently

Yoshimasu et al. (2010) reported a gender ratio of approximately 3.19:1 for students with both reading disability and ADHD, compared to a gender ratio of approximately 1.89:1 for students with reading disability only.

Although a clear link between reading disability and behaviour has been previously established (Rowe & Rowe, 1999; Smart et al., 2001), the nature of this relationship is still unknown, whether it be causal or correlational. While some researchers have found evidence to suggest that behaviour leads to reading disability (Morgan, Farkas, Tufis, & Sperling, 2008; Smart et al., 2001), others have reported that reading disability leads to later problem behaviour (Bennett, Brown, Boyle, Racine, & Offord, 2003).

Irrespective of the nature of this relationship, however, there is evidence to suggest that although problem behaviour may lead to more referrals for boys, it does not necessarily mean that there are actual gender differences in reading ability. A number of researchers have employed both behavioural and reading measures to single populations and found that while there are significant gender differences in behaviour, there are often non-significant differences in reading ability. Smart et al. (2001) reported that while significantly more boys were reported as being high risk for behaviour problems, there were no significant gender differences in measures of reading comprehension. Furthermore, these researchers concluded that other factors such as intelligence and socioeconomic status were more likely to impact on reading ability. Others have reported similar findings (Matthews, Ponitz, & Morrison, 2009; Willcutt & Pennington, 2000). Although problem behaviour does not consistently account for gender differences in reading, it does play a considerable role for gender differences in rates of referral.

Recognising that referral bias can exaggerate gender ratios for reading disability, a number of population-based studies have been conducted to ascertain the prevalence of reading disabilities in boys and girls in less biased samples. Perhaps the most notable is Shaywitz et al.'s (1990) study outlined above. Flannery et al. (2000) reported gender differences based on a sample of 32,223 students (see Table 1 for details). When controlling for race and severity of reading disability, they reported a prevalence of 1.88:1 for boys. A recent study by Limbrick, Wheldall, and Madelaine (2010) examined the performance of students on the National Assessment Program – Literacy and Numeracy (NAPLAN). In 2008 the NAPLAN was the first large-scale assessment introduced Australia-wide, providing a unique opportunity to gauge gender ratios for poor reading Australia-wide for the first time. A sample of more than one million students across Years 3, 5, 7 and 9 was employed. Limbrick et al. reported gender ratios for reading performance of between 1.44:1 and 1.68:1 across school years. In population samples, as well as in clinical samples, then, it is evident that there is variability in reported gender ratios for reading disability. This variability becomes even more evident, though, when studies based on population samples are compared with studies that are based on clinical samples.

Conclusion

From the evidence presented in this review that there appear to be, on the whole, more boys than girls diagnosed with reading disability, although in studies using population samples the gender ratios are much closer to 1:1. Throughout the literature, however, there are large discrepancies as to the degree to which there are more boys. The most popular methods of reading disability identification are discrepancy, low achievement and RTI, but inconsistencies in assessments, cut off points and inclusion/exclusion criteria across studies

have meant that gender ratios not only vary among definitions of reading disability, but also within definitions. For discrepancy formulae, gender ratios ranged from 1.39:1 (Rutter et al., 2004) to 4.51:1 (Miles et al., 1998), whereas gender ratios reported using low achievement models were somewhat lower, ranging from non-significant differences of 1:1 and 1.2:1 (Siegel & Smythe, 2005; Prior et al., 1995) to 3.19:1 (Rutter et al., 2004). Gender ratios for RTI models were also relatively low (Vaughn et al., 2003; VanDerHeyden et al., 2007). There is also evidence to suggest that methods of sample selection exaggerate gender ratios, particularly in referred samples.

Liederman et al. (2005), in their comprehensive review of the literature on the prevalence of boys, concluded that an overall gender ratio of between 1.74:1 and 2:1 is most likely. The majority of studies in their review, however, employed some form of discrepancy formulae. As indicated earlier, there is growing scepticism for discrepancy methods, both logistically and statistically. On the other hand, there is also growing evidence to suggest that reading disability, or ability, is continuous in nature and defined by the degree to which a child lags behind their peers (Coltheart & Prior, 2007). Although all methods of reading disability identification have advantages and disadvantages, a cautious approach to estimating the true prevalence of reading disability for boys and girls may be to examine research complementary to the continuous, rather than dichotomous, nature of reading skills. For instance, several studies in this review that employed methods that isolated the tail end of the distribution reported non-significant or very small gender differences (Siegel & Smythe, 2005; Prior et al., 1995). Rutter et al. (2004) also used this method but reported much higher gender ratios in two New Zealand samples, although it was acknowledged that New Zealand had higher sex differences in literacy levels than

many other countries. As indicated earlier, variations in reported gender ratios have arisen as a result of inconsistencies in samples, distributions, reading measures, and cut off points. Future research might therefore consider examining gender ratios of reading disability in whole populations, using the same reading measure and cut off points, over a significant time period. More attention should also be given to differences not only in reading means but also in the variability of boys' scores. As discussed, boys' greater variability in scores may have a considerable impact on reported gender ratios.

To date there appears to be very few studies which report gender ratios using RTI methods. Such studies discussed in this review reported notably low gender ratios, compared to other methods of reading disability identification. While there is still relatively little data available, it begs the question of whether the low gender ratios in RTI are a result of employing criterion-referenced assessment rather than norm-referenced assessment. Future research may answer this question.

Finally, it is worth acknowledging that different definitions of reading disability serve different purposes, particularly when it comes to eligibility for special education services (Chan et al., 2007). In the United States, the use of discrepancy formulae to identify reading disability has been deeply entrenched (Fuchs et al., 2003), although RTI is emerging as a popular alternative. Indeed, the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) promotes the use of RTI. In Australia, however, reading disability is not even a disorder that qualifies for the provision of special education services. While different definitions exist to serve different purposes, it appears unlikely that a single definition of reading disability will ever be agreed upon. What may be more fundamental to the debate, perhaps, is a call for widespread understanding on the

constituents of poor reading; namely, deficiencies or delays in phonological processing, including fluency and accuracy (Siegel & Smythe, 2005; Catts et al., 1999). Furthermore, an understanding of the continuous, rather than dichotomous, nature of reading ability is also fundamental (Coltheart & Prior, 2007; Siegel & Smythe, 2005). The need for such understanding in future research is paramount if consistent and accurate gender ratios for reading disability are to be identified.

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Table 1
Empirical studies reporting gender ratios of reading disability

Study	Year	Definition of Reading Disability	Sample	Gender Ratio of Reading Disability (by Definition)
Badian	1999	Two measures of Reading Disability (RD): (a) Discrepant poor reading: Reading comprehension score <25th percentile on the Scholastic Aptitude Test (SAT), and >1.5SDs below the expected level based on listening comprehension (b) Non-Discrepant poor reading: Reading comprehension score <25th percentile and >1.5SDs below expected level predicted on listening comprehension.	n=1,008	Discrepant RD: 3.2:1 Non-Discrepant RD: 1.3:1
Beringer, Nielsen, Abbott, Wijsman, & Raskind	2008	Dyslexia measured a score of at least 90 on WISC-3 Verbal IQ and at least 1SD below population mean on Verbal Comprehension Factor (measure of oral reading accuracy or rate).	n=122	Dyslexia: 3.64:1
Chan, Suk-han Ho, Suk-man Tsang, Suk-han Lee, & Chung	2008	Three measures of dyslexia: (a) Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD): score <7 (M=10, SD=3) (b) The difference between IQ score and literacy composite score equals or exceeds a specified number of standard deviation units (1.0 or 1.5 SD). (c) The difference between predicted literacy score and score predicted by IQ.	n=690	HKT-SpLD: 2.05:1 Discrepancy: 2.19:1 Regression: 2.26:1
Chan, Suk-han Ho, Suk-man Tsang, Suk-han Lee, & Chung	2007	Dyslexia measured on the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD). Mild dyslexia is a score between 7-5.5 (M=10, SD=3) on literacy test domain and on one or more cognitive test domains; moderate dyslexia is a score between 7-5.5; and severe dyslexia is a score <4.	n=690	Dyslexia (mild): 1.9:1 Dyslexia (moderate): 2.8:1 Dyslexia (severe): 2.0:1

Coutinho & Oswald	2005	Learning Disability (LD) measured by various methods depending on US States.	n=88,650 schools	LD: 2.05:1* *(*Ratios varied from 1.5:1 to 3.5:1 depending on US States)*
Dirks, Spyer, van Lieshout, & Sonneville	2008	Low Achievement: a score below the 25th percentile on Cito Drie Minuten Toets (word recognition) and Cito Begrijpend Lezen (reading comprehension).	N=799	RD (25th percentile): 1.01:1 RD (10th percentile): 0.88:1 RD (25th):80 boys, 79 girls RD (10th): 30 boys, 34 girls
Flannery, Liederman, Daly, & Schultz	2000	Reading Disability (RD) measured by a discrepancy regression. Reading performance on the Wide Range Achievement Tests (WRAT) >1.5SDs (for moderate RD) or >2SDs (for severe RD) below prediction on the Wechsler Intelligence Scale for Children (WISC) Full Scale IQ score.	n=32,223	White children: Moderate RD: 1.88:1 Severe RD: 2.33:1 Black children: Moderate RD: 2.05:1 Severe RD: 2.35:1
Hawke, Wadsworth, & DeFries	2006	Reading Disability is defined as a score >90 on either a Verbal IQ or Performance IQ score using the WISC-R, plus a history of reading problems.	n=478	RD: ns
Heim et al.	2008	Dyslexia: a score at or below 10th percentile on the Wűrzburger Silent Reading Test and subsequent non-verbal intelligence score in the average or above-average range.	N=97	Dyslexic: 0.94:1 (24 girls, 21 boys)
Hoskyn & Swanson	2000	Two definitions and measures: (a) Reading Disability (RD): a Verbal IQ score >80, and standardised reading measures <90 (25th percentile). (b) Low Achievement (LA): Standardised reading recognition scores <40th percentile, VIQ score 96-70.	Compared 19 studies	RD: 3.1:1* *(*Ratios varied across studies)*

Jimenéz, García de la Cadena, Siegel, O'Shanahan, García, & Rodríguez	In press	Dyslexia: (a) Absence of sensory, neurological or other problems; (b) score <25th percentile on pseudoword reading (Spanish Standardized Multimedia Battery SICOLE-R) or score >75th percentile on reading time for pseudoword reading task; (c) IQ>75	N=1,048	RD (Spain): 1.48:1 RD (Guatemala): 1.44:1 (Spain: 98 boys, 66 girls) (Guatemala: 65 boys, 45 girls)
Katusic, Colligan, Barbaresi, Schaid, & Jacobsen	2001	Four measures of Reading Disability (RD): (a) Regression formula (Minnesota): reading achievement >1.75SD below predicted score from an IQ score (b) Regression formula (Shaywitz): reading achievement on Woodcock-Johnson >1.5SD below predicted score from Full Scale IQ score (c) Discrepancy (non-regression): difference between standard scores on measures of intelligence and reading achievement (d) Low Achievement (LA): a score >80 on an aptitude measure, and a score <90 on an achievement measure.	n=5,718	Discrep. (Minnisota): 2.98:1 Discrep. (Shaywitz): 2.72:1 Non-Reg: 2.85:1 LA: 1.98:1
Landerl & Moll	2010	LD: at least 1SD below norm in arithmetic, reading and/or spelling. Reading assessment was a standardised sentence reading test.	N=2,586	LD: 1.1:1 (52.4% boys, 47.6% girls)
Locascio, Mahone, Eason, & Cutting	2010	Word recognition deficit (WRD): score <25th percentile on the Basic Skills Cluster of the Woodcock-Reading Mastery Test-Revised. Reading comprehension deficit (RCD): score >37th percentile on WRMT-R but score <25th percentile on at least two of five reading comprehension measures.	N=86	WRD: 1.93:1 RCD: 1:1 (WRD: 29 boys, 15 girls) (RCD: 9 boys, 9 girls)
Miles, Haslum, & Wheeler	1998	Discrepancy formula, with the addition of spelling scores. Single word testing rather than reading comprehension.	n=11,804	RD: 4.51:1

Pereira-Laird, Deane, & Bunnell	1999	Reading Disability (RD) 5-stage assessment model: (a) Teacher recommended: low reading achievement in class (b) Low Achievement: Below or equal 25th percentile in a reading PAT test (comprehension or vocabulary) (c) Intraindividual differences in academic achievement/Discrepancy: At least one PAT score below 25th percentile and one PAT score greater or equal to 30th percentile (d) No evidence or history of disadvantage: School records were reviewed. (e) Prorated IQ scores of 85 or more	n=407	RD (approx): 1.43:1* (*This is an approximate ratio based on data reported: 58.8% boys and 41.2% girls)
Prior, Samson, Smart, & Oberklaid	1995	Reading Disability (RD) measured by a score of >1SD below the mean on the Australian Council for Educational Research (ACER) Word Knowledge Test.	n=156	RD: 1.27:1 (This is an approximate ratio based on data reported: 56% boys and 44% girls)
Rutter, Caspi, Fergusson, Horwood, Goodman, Maughan, Moffitt, Meltzer, & Carroll	2004	Two measures of Reading Disability (RD) across four samples (Dunedin, New Zealand; Christchurch, New Zealand; Office for National Statistics Study (ONS), UK; and Environmental Risk Longitudinal Twin Study (E-risk), UK): (a) Non-IQ Referenced (Low Achievement): Reading scores in lowest 15% of distribution. (b) IQ-Referenced (Regression/Discrepancy): Reading score <1SD below predicted reading score from WISC-R Performance IQ.	Dunedin n=895 C'church n=895 ONS n=5,752 E-risk n=2,163	Dunedin Non-IQ: 3.19:1 Dunedin IQ: 3.29:1 C'Church Non-IQ: 2.38:1 C'Church IQ: 2.76:1 ONS Non-IQ: 1.43:1 ONS IQ: 1.74:1 E-risk Non-IQ: 1.39:1 E-risk IQ: 1.93:1

Share & Silva	2003	Reading Disability (RD) measured by Rutter & Yule's regression equation: reading scores <1.5SDs below prediction based on PIQ. Calculated gender ratios based on separated distributions and combined distributions for boys and girls.	n=914	RD (separated): 1.02:1* RD (combined): 1.79:1* *(*This is an approximate ratio based on data reported.* *Separated distributions: 92/471 boys (19.5%) and 85/443 girls (19.1%).* *Combined distributions: 118/471 boys (25%) and 62/443 girls (14%).*
Siegel & Smythe	2005	Reading Disability: 1SD (standard score <85) and 2SDs (standard score <70) on WRAT, Woodcock-Johnson (W-J) Word Identification, and W-J Word Attack	n=984	RD (1SD): ns RD (2SD): ns
Stevenson	1992	Three measures of reading disability, each calculated using combined and separate distributions for boys and girls: (a) Regression of raw Reading Composite and Spelling scores onto WISC-R IQ Full Scale (b) Discrepancy method between WISC-R Full Scale IQ and Reading Composite and Spelling scores (c) Age only method (not taking into account IQ) for Reading Composite score	n=570	Regression (comb'd): 1.87:1 Regression (sep): 1.15:1 Discrepancy (comb'd): 3.07:1 Discrepancy (sep): 2.04:1 Age only (comb'd): 1.64:1 Age only (sep): 1.09:1
Shaywitz, Shaywitz, Fletcher, & Escobar	1990	Reading Disability (RD) defined by an ability-achievement discrepancy. Two criteria: (a) Research identified: ability (WISC-R, Full Scale IQ)-achievement (W-J Reading Cluster) discrepancy (b) School identified: identified by school as reading disabled and eligible for special education services (excepting children with FIQ<80).	n=414	Research-identified: Year 2 = 1.26:1* Year 3 = 1.5:1* School-identified: Year 2 = 4.25:1* Year 3 = 2.38:1* (*These are approximate ratios based on data reported: *Research Identified:* *Year 2 – 8.7% boys, 6.9% girls* *Year 3 – 9.0% boys, 6.0% girls* *School Identified:* *Year 2 – 13.6% boys, 3.2% girls* *Year 3 – 10% boys, 4.2% girls*

Undheim & Sund	2008	Self-reported reading disability (RD) by answering two questions. Adolescents were included in the RD sample if they indicated they had dyslexia, and if they indicated dyslexia was a 'large' problem or 'some' problems	n=2,464	RD: 1.21:1 (Girls: 7.0%, Boys: 8.5%)
VanDerHeyden, Witt, & Gilbertson	2007	Response to Intervention: System to Enhance the Educational Performance (STEEP) program consisting of curriculum-based measures (identified RD if score more than 1 standard deviation below mean)	n=5 schools	RD: 1.35:1
Willcutt & Penningnton	2000	Discrepancy between reading achievement (Peabody) and expected achievement based on age. RD= 1.65SD below mean on Peabody, and WISC-R / WAIS for IQ	n=867	RD: 1.22:1 RD+ADHD: 3.76:1
Yoshimasu et al.	2010	Three formulas for Reading Disability: (a) Regression Formula – Minnesota: standard reading achievement scores >1.75SD below predicted IQ standard score (b) Discrepancy Formula: differences between age-based standard scores for intelligence and reading depending on grade (c) Low Achievement: IQ>80 and reading standard score <90 Students with ADHD were identified through school records and behaviours observed by parents, teachers, school counsellors, social workers, doctors, etc.	n=5,718	RD: 1.89:1* RD+ADHD: 3.19:1* *(*These are approximate ratios based on data reported: RD:332 boys, 176 boys RD+ADHD: 137 boys, 43 girls)*

CHAPTER 3: WHY DO MORE BOYS THAN GIRLS HAVE A READING DISABILITY? A REVIEW OF THE EVIDENCE

Chapter Overview

This Chapter includes a literature review published in the *Australasian Journal of Special Education* (Limbrick, Wheldall, & Madelaine, 2011) and was awarded the Lee Mills Award for 2010.

The findings from the previous chapter (Chapter 2) illustrate the extent to which existing studies vary in terms of defining poor reading, the assessments employed to identify poor readers, methods of sample selection and the analysis of results. The findings in Chapter 2 confirmed that previously reported gender ratios for poor reading have been influenced by these methodological factors to some degree. Consistent with previous research, it was found that gender ratios may be artificially inflated by factors such as sample selection (Shaywitz et al., 1990) and methods of identifying poor readers (Share & Silva, 2003). There was also evidence to suggest that more boys than girls are identified as poor readers because boys tend to demonstrate a greater variability in reading scores than girls (Hawke et al., 2009). It was important to identify the methodological factors which have influenced, and possibly over inflated, reported gender ratios for poor reading because these factors need to be taken into consideration if accurate gender ratios are to be eventually established. What was not addressed in Chapter 2, however, was the possibility that there may be other explanations as to why more boys than girls have been previously identified as poor readers, beyond methodology.

In recent years a number of explanations have been proposed to account for reported gender differences in poor reading. Rowe and colleagues (2006, 2006a, 2004), for example,

have been strong advocates for the theory that gender differences in reading are a result of auditory processing difficulties. Others have suggested that gender differences in problem behaviour accounts for a greater proportion of boys identified as poor readers (Prochnow, Tunmer, Chapman, & Greaney, 2001; Smart et al., 2001; Trzesniewski et al., 2006). Explanations relating to differences in phonemic awareness, neurology, variability in cognitive ability, and reading motivation have also been proposed. The evidence supporting each of these explanations, however, is somewhat conflicting. Consequently, the following literature review was written to examine the weight of the evidence supporting each explanation in detail. This was considered an important step in determining whether any one explanation could satisfactorily clarify why a reportedly larger proportion of boys have been identified as poor readers, beyond methodological factors. If any explanations could satisfactorily account for more boys identified as poor readers, then this may possibly substantiate the development of different forms of remediation for boys and girls.

In the following literature review, the empirical evidence supporting each explanation was discussed in separate sections, commencing with a brief summary followed by a discussion of the available evidence. Preliminary findings indicate that although each explanation accounts, in part, for reading success generally, no single explanation sufficiently accounted for reported gender differences in poor reading. Furthermore, where effect sizes for gender differences were reported, these were consistently small. There was little evidence to suggest that boys and girls require separate forms of reading remediation. The question remained, however, as to whether there are actually more boys than girls who are poor readers. This paper provided one of the first comprehensive reviews of different theoretical explanations to account for reported gender ratios for poor reading.

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Why Do More Boys Than Girls Have a Reading Disability? A Review of the Evidence

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A number of explanations have been proposed in recent years to account for the observed preponderance of boys with a reading disability. The most notable explanations offered for gender differences in reading disability relate to differences in phonemic awareness, auditory processing, behaviour, neurology, variability in cognitive ability and reading motivation. The purpose of this article was to review the available evidence supporting each of these explanations. The impact of confounding variables, including sample selection, sample bias, intelligence, and socioeconomic status was also discussed. Although the different explanations have, to some degree, an impact on overall reading achievement, it does not appear that any single explanation wholly accounts for gender differences in reading ability, and that gender is not a strong or consistent predictor of reading success.

Keywords: gender, reading disability, instructional outcomes

The issue of gender differences in reading has received considerable attention in recent decades. A recurrent theme in the literature is that poor reading, or reading disability, is more prevalent in boys, although the degree of prevalence remains contentious (Limbrick, Wheldall, & Madelaine, 2008). While some have found that there are small or no gender differences in reading disability (Siegel & Smythe, 2005), others have reported gender ratios of up to 4.51:1 (Miles, Haslum, & Wheeler, 1998). As indicated by Limbrick et al. (2008), conflicting reported gender ratios for reading disability stem from methodological factors such as differences among the assessment measures, differences in cut-off points for severity ratings, and differences among the samples with regard to age (mean and range), referral basis (community or clinic), and cognitive ability. Furthermore, differences in these methodologies ultimately stem from differences in theoretical orientations; in other words, the explanations used to account for poor reading generally. For example, while some researchers approach poor reading from a neurological perspective (Liederman, Kantrowitz, & Flannery,

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2005), others advocate a language approach (Catts, Fey, Zhang, & Tomblin, 1999). Estimates of the overall number of children with reading problems vary considerably depending upon the approach taken (Chan, Ho, Tsang, Lee, & Chung, 2007); so, too, do estimates of gender ratios for poor reading.

A number of explanations have been directly proposed to account for the reported preponderance of males with a reading disability. One explanation is that gender differences in phonemic awareness translate to gender differences in poor reading, or reading disability. Phonemic awareness is a subset of phonological awareness and critical in learning to read (Burt, Holm, & Dodd, 1999). If there are more boys than girls who are struggling with phonemic awareness, then this would account for the reported higher percentage of boys who struggle with reading.

A second explanation relates to auditory processing. Research indicates that there is a link between reading disability and auditory processing disorders (Sharma et al., 2006), and that there are twice as many boys presenting with auditory processing disorders than there are girls (Schminky & Baron, 2000). As a result, it has been hypothesised that gender differences in auditory processing account for the observed differences between boys and girls in rates of reading disability.

Gender differences in externalising problem behaviour (or troublesome behaviour) are a third explanation that has been proposed to account for gender differences in reading disability. A significant body of research has established a link between problem behaviour and reading disability (Smart, Prior, Sanson, & Oberklaid, 2001), and that externalising problem behaviour is displayed more often in boys than in girls (Beaman, Wheldall, & Kemp, 2007). It is unclear, however, whether the relationship between problem behaviour and poor reading is correlational, causal or reciprocal (Sanson, Prior, & Smart, 1996; Spira, Bracken, & Fischel, 2005), particularly when there is evidence to support each relationship. Problem behaviour may be a valid explanation for gender differences in poor reading depending on the evidence, particularly evidence indicating problem behaviour causes poor reading.

A fourth explanation relates to neurological differences between boys and girls. Evidence suggests that boys are more left lateralised, whereas girls are more bilateralised, and these differences are evident in reading tasks (Coney, 2002; Phillips, Lowe, Lurito, Dzemidzic, & Mathews, 2001). Research shows that boys and girls access different neural pathways when undertaking reading and reading-related tasks, and this has been hypothesised to explain observed differences between boys and girls in reading outcomes and rates of reading disability.

A fifth explanation relates to gender differences in cognitive ability scores. It has been demonstrated that boys show greater variability on cognitive ability measures, which results in a preponderance of boys at the extreme ends of the distribution (Lohman & Lakin, 2009). Girls, on the other hand, tend to cluster more closely around the mean (Lynn & Mikk, 2009). This phenomenon is also evident across a range of educational domains. In terms of reading, there are often more boys than girls in the bottom of the distribution. It is hypothesised, then, that more boys are identified as having a reading disability because of this greater variability in reading scores.

A final explanation to account for the observed preponderance of boys with a reading disability is gender differences in reading motivation. Girls have been reported to have an overall higher level of motivation for reading than boys (Kelley & Decker, 2009; Mucherah & Yoder, 2008) and value reading more than boys (Baker & Wigfield, 1999). If girls are more motivated than boys to read, and motivation plays an important role in reading achievement (Mucherah & Yoder, 2008), then this may explain why girls

outperform boys in reading. Like problem behaviour, however, the relationship between motivation and reading is not clearly understood, which has implications as to whether reading motivation leads to poor reading or vice versa.

As will be discussed, each of these explanations is empirically supported to some degree, but there is also evidence to the contrary. In other words, there is also evidence to suggest that such gender differences are not significant or non-existent, or that significant results are confounded by other methodological or social variables. Examining the evidence supporting these explanations is important for several reasons. First, identifying whether any of the explanations sufficiently account for the observed greater prevalence of boys with reading disability has implications for the direction of future research. Understanding the nature of the relationship between gender and reading could assist in determining whether boys might require different forms of remediation, and what forms of remediation would be most beneficial, whether it be motivational, behavioural, neurological, and so forth.

Second, it would be useful to determine whether any of the explanations identify gender as a strong or reliable predictive variable in reading. In recent years several strong predictors of reading outcomes have been well established, such as phonemic awareness. If gender is identified in any of the above explanations as a strong predictive variable of reading outcomes, then this should also be established for future investigations. For instance, to what degree is gender thought to impact reading outcomes in terms of behaviour or motivation? Furthermore, are these observed differences a result of the behaviour or motivation, or in the actual reading? In the current state of research, discrepancies among reported gender ratios of poor reading have made it difficult to ascertain whether there are reliable or consistent differences between boys and girls in reading, or whether these differences are a result of other confounding variables.

The purpose of this review is to examine the validity of phonemic awareness, auditory processing, behaviour, neurology, and variability in cognitive ability scores, and motivation as explanations for gender differences in reading. Articles were included in this review if they met specific inclusion criteria: (a) published in a refereed academic journal; (b) reported findings of an empirical study; and (c) published in the past decade, although some highly influential earlier studies will be included (for example, Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). A number of key descriptors were used in searching for relevant articles, including 'boy(s)', 'gender', 'reading', 'disability', 'dyslexia', 'reading difficulty', 'low progress reading', and 'poor reading'. Key descriptors pertaining to each explanation were also used. These descriptors were used in various combinations on a number of educational and psychological online databases, including Expanded Academic, Informaworld, PsychInfo and ERIC. Additional searches were conducted in Google Scholar. The age range of participants in selected studies was predominantly between 6 years and 12 years. Several studies also included results for 15-year-old students who participated in the Programme for International Student Assessment (PISA), which is administered across 41 countries.

The six explanations explored in this review will be discussed in separate sections. Each section will commence with a brief resume of the argument, followed by a discussion of the available empirically based evidence. The impact of confounding variables will be discussed where applicable, including sample selection and sample bias, intelligence, and socioeconomic status. Implications for future research in gender and reading will also be discussed.

Phonemic Awareness

Over the past 30 years it has become well established that phonological awareness is one of the strongest predictors of reading success (Gernand & Morgan, 2007; Linklater, O'Connor, & Palardy, 2009; Savage & Carless, 2004), and accounts for more variance in reading ability than any other factor, including intelligence, age and socioeconomic status (Burt et al., 1999). Singleton, Horne, and Thomas (1999), for instance, reported that phonological awareness accounted for up to 54% of variance in reading. Phonological awareness is an awareness or knowledge of sound structure and the capacity to manipulate these sounds (Burt et al., 1999; Linklater et al., 2009), and is generally accepted to constitute three primary subsets: syllabic, intrasyllabic, and phonemic awareness (Burt et al., 1999). Phonemic awareness is considered critical in learning to read, and involves the capacity to discriminate and manipulate phonemes within words orally (Phillips, Norris, & Steffler, 2007). It may be plausible, then, that if there are gender differences in phonemic awareness, then this may be a contributing factor to the reported greater prevalence of boys with a reading disability.

Extensive research has been conducted in the area of phonemic awareness (as a subset of phonological awareness; Phillips et al., 2007), and despite the wealth of research available, few studies have examined gender differences (Gernand & Morgan, 2007). From the evidence available, it has been demonstrated that girls perform better than boys in phonological development (Dodd, Holm, Hua, & Crosbie, 2003; Gernand & Morgan, 2007) and language acquisition (Halpern & LaMay, 2000; McCormack & Knighton, 1996). Recent studies have found that girls perform significantly better than boys in phoneme segmentation tasks (Linklater et al., 2009; Moura, Mezzomo, & Cielo, 2008), accessing and using phonological name codes (Majeres, 2006), and achieve a higher rate of phonemes pronounced correctly (Dodd et al., 2003). Gender differences in phonological or phonemic awareness, however, appear to vary with the nature and complexity of the task at hand. For example, Moura et al. (2008) reported that girls had superior phonemic synthesis and segmentation skills, as well as 'phonemic reversion for words with two or three phonemes' (p. 53). Boys, on the other hand, were significantly better at 'phonetic synthesis for words with seven phonemes, and phonemic reversion for words with four or five phonemes' (p. 53). In this sample of children aged between 7:2 and 8:8 years, boys and girls differed according to task complexity, although it was acknowledged that these gender differences, albeit statistically significant, were very small.

Linklater et al. (2009) also found, in a sample of 401 kindergarten students, that girls demonstrated significantly better phoneme segmentation skills; however, boys and girls performed similarly in terms of initial sound fluency. By the end of kindergarten, girls had made faster progress in initial sound fluency, but boys had made faster progress in phonemic segmentation. Although girls were higher in both initial sounds fluency and phonemic segmentation at the end of kindergarten, Linklater et al., similar to Moura et al. (2008), concluded that the gender differences were extremely small, and gender was not a significant predictor of later reading success.

Of the studies exploring the role of gender in phonemic awareness, it appears that some have found differences that, although significant, are relatively small. Other studies have reported no gender differences at all. Savage and Carless (2004), for example, assessed a sample of 435 children at ages 4–5, 5:8 and 7 years on a range of phonological abilities, including phonemic tasks such as segmenting and blending, to ascertain the predictive validity of phonological ability for curriculum and academic test performance. Phonological awareness was a strong predictor for reading, mathematics

and science. While gender was a significant predictor for writing, mathematics and science, there were no significant differences between boys and girls on any of the phonological or phonemic tests. A further study (Savage, Carless, & Ferraro, 2007) found that phonological abilities at age 5 years significantly predicted academic outcomes at age 11 years (including reading, writing, English, mental arithmetic, mathematics, science). Gender predicted several academic outcomes, but no differences in phonological ability were reported. This included tasks such as phoneme blending and segmentation.

In a more recent study, Papadopoulos, Spanoudis, and Kendeou (2009) examined phonological abilities in the Greek language. In a sample of 280 Greek-Cypriot kindergarten and Year 1 children (141 boys), a range of phonological skills were assessed across 10 tasks. Four of those tasks measured phonemic abilities, and included initial sound oddity, sound isolation, phoneme elision (repeating a word after deleting a recognised phoneme), and phoneme blending. Across kindergarten and Year 1 there were no significant differences between boys and girls in any of the phonological abilities measured, including those tasks measuring phonemic awareness. In addition, kindergarten boys scored slightly higher than kindergarten girls in the phonemic tasks.

Nonsignificant gender differences in phonological awareness, and more specifically phonemic awareness, have also been reported for preschool children. Burt et al. (1999) assessed 57 children (without disability) on word production, phonological variability, non-word imitation, syllable segmentation, rhyme awareness, alliteration awareness, phoneme isolation and phoneme segmentation. Socioeconomic status and age both correlated significantly with the majority of tasks, but gender did not. Boys and girls did not differ on any of the phonological tasks, including phonemic tasks. Others have reached similar conclusions (Gernand & Morgan, 2007; Phillips et al., 2007). Fluss et al. (2009) found that while gender was not a significant predictor, other factors including socioeconomic status accounted for 24.2% of variance in reading. Similar findings are also consistent across a number of countries, including Canada (Phillips et al., 2007), Finland (Puolakanaho et al., 2007), and France (Fluss et al., 2009).

Although a considerable number of interventions are available to improve phonological and phonemic awareness (see, e.g., Treutlein, Zöller, Roos, & Schöler, 2008), there is little evidence to suggest that boys and girls require separate forms of remediation. Savage and Carless (2004) indicated that gender differences in phonological and phonemic awareness at school entry are so small, that boys and girls should be treated similarly. Likewise, Linklater et al. (2009) concluded that even though rates of growth for boys and girls differed, this did not lead to any differences in reading outcomes. As a result, they encourage educators to 'focus on the desired outcomes and provide the appropriate instruction for achieving them regardless of gender' (p. 22). Moura et al. (2008) also suggested that separate interventions were not warranted.

Phonemic awareness is critical to early reading development and later reading success, but evidence suggesting that gender differences in phonemic awareness, or even phonological awareness, accounts for more boys than girls with a reading disability is sparse. A number of studies have reported significant gender differences in phonemic or phonological awareness, although it has been conceded that these differences are relatively small. Other studies have reported small or no differences at all between boys and girls. Additionally, there is evidence to suggest that boys and girls have different strengths in aspects of phonological awareness depending on the nature and complexity of the task. It does not appear, however, that these differences consistently predict later reading success. Although differences in phonemic awareness may account for

differences in reading ability, it does not appear that they account for observed gender differences in reading disability.

Auditory Processing Disorders

Aside from phonemic awareness, another line of research postulates that gender differences in auditory processing may account for why there have been more boys than girls reported as having a reading disability. A number of studies have suggested a link between reading disability and auditory processing disorders (Amitay, Ben-Yehudah, Banai, & Ahissar, 2002; Sharma et al., 2006; Walker, Shinn, Cranford, Givens, & Holbert, 2002). Auditory Processing Disorder (APD), or Central Auditory Processing Disorder (CAPD), is commonly defined as problems with how auditory information is processed in the brain (National Institute on Deafness and Other Communication Disorders, 2009), particularly recognising and discriminating sounds (Moore, 2007). It is believed that a deficiency in auditory processing can affect fundamental phonological skills which are essential for reading (Dlouha, Novak, & Vokral, 2007; Heim et al., 2008; Sharma et al., 2006; Veuillet, Magnan, Ecalle, Thai-Van, & Collet, 2007). APD has been often associated with reading disorders (Moore, 2007; Sharma, Purdy, & Kelly, 2009), and is said to be exacerbated by background noise, such as a typical classroom environment (Veuillet et al., 2007). The disorder is often difficult to evaluate, however, because it can overlap with other disorders such as attention or language impairments (Dawes & Bishop, 2009). Although there is no 'gold standard' for measuring APD (Domitz & Schow, 2000, p. 1), it is often assessed by a range of behavioural tests (speech and noise) and electrophysiological tests (measuring the brain's response to sounds; Schminky & Baron, 2000).

Similar to research on phonological awareness, there is also a plethora of research on APD and reading disorders (see, e.g., Jutras et al., 2007; Sharma et al., 2009; Veuillet et al., 2007), but very few studies reporting data on gender (van Kesteren & Wiersinga-Post, 2007). In previous years it has been suggested that there are twice as many boys with APD than girls (Chermak & Musiek, 1997; Schminky & Baron, 2000), although these findings are mixed.

Rowe, Rowe, and colleagues (2006, 2006a, 2004) are among the handful of researchers who have addressed the issue of APD, reading disorders and gender. Rowe and Rowe (2006) found that a large number of children who were referred for literacy and/or behavioural assessments also presented with auditory processing difficulties, and the majority of these referred children were boys. Furthermore, in a summary of research findings based on a large sample of children in Victoria, Rowe, Rowe, and Pollard (2004) reported a strong relationship between reading achievement, attention and behaviour, and auditory processing. Boys were approximately 1 year behind girls in auditory processing development. In a sample of 9,028 children (4,471 males, 4,557 females) aged 4:7 years to 12 years, significant gender differences in favour of girls were found on two auditory processing tasks, being digit span and a sentence length task. Although these findings are significant, it should be noted that Rowe and Rowe (2006) indicated that the majority of students referred to specialists are boys. Previous findings have demonstrated that there are often more boys than girls in referred samples (Hawke, Wadsworth, Olson, & DeFries, 2007). Because it has been demonstrated that APD is often comorbid with problem behaviour, and problem behaviour is more prevalent in boys (as will be discussed in the following section), it is unclear whether more boys are referred for APD because APD is more prevalent in boys, or whether problem behaviour

precipitates more frequent referrals for boys. Additionally, Rowe, Rowe, and colleagues have measured AP by tasks involving repetition of sentence length and digit span. Although sentence length and digit span tasks measure AP in part, these studies did not include measures of electrophysiological tasks. Finally, no effect sizes were reported in these studies, and therefore the degree to which gender differences in APD accounts for gender differences in poor reading is ambiguous.

Interventions specifically for boys with auditory processing difficulties are minimal. Of the few researchers who advocate intervention programs for boys, Rowe and Rowe (2006) indicate that the strategies are effective for all students, regardless of gender. Rowe and Rowe have developed a teacher professional development program to encourage communication in the classroom, and devised an Auditory Processing Assessment Kit for purchase, which includes a sentence length and digit span assessment, which can be administered by teachers.

Although there are few studies reporting gender data, there is evidence to suggest little or no significant gender differences in auditory processing, even in referred samples. Ghanizadeh (2009) recently examined the comorbidity of APD, attention deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), separation anxiety disorder (SA) and gender, on a sample of 104 children (mean age 8:5 years). Auditory dysfunction was measured by a checklist of screening signs for APD and included hypersensitivity to sounds (HES) and hyposensitivity to sounds (HOS), which are two common aspects of APD. In this referred sample, where there were 73.1% boys, there were no significant gender differences in either HES or HOS.

A lack of gender differences in APD has also been evidenced in non-referred samples. Domitz and Schow (2000), for example, devised a CAPD battery of four commonly used tests (Selective Auditory Attention Test, Pitch Patterns, Dichotic Digits, and Competing Sentences) and assessed a non-referred sample of 81 Grade 3 students. Although girls scored slightly higher on the tasks than boys, most of these differences were not significant. Rowe et al. (2004) also reported data on a random sample of 889 Victorian children at school entry, and although they found significant gender differences on literacy tasks (BURT Word Reading Test, South Australian Spelling Test) and attentiveness, the interaction between digit span and gender was not significant.

There are several potential explanations for the disparities in reported research findings. First, very few empirical studies on APD and reading disability report gender data. As indicated by van Kesteren and Wiersinga-Post (2007), the majority of studies on auditory processing and reading do not report outcomes by gender, and therefore the role of gender is ambiguous. Discrepancies among the few reported findings, then, are difficult to interpret. It may be possible that researchers find no gender differences when analysing data and therefore do not report them, but in the absence of empirical evidence, it cannot be said with certainty whether gender differences in auditory processing do or do not play a role in reading ability.

Second, as discussed earlier, because there is not a widely accepted method of diagnosing APD, evidence suggests that different tests and measures yield different results (Sharma et al., 2009). Rowe, Rowe, and colleagues (2004, 2006) reported significant gender differences in measures of repetitive sentence length and digit span, while others have found nonsignificant gender differences in hypersensitivity/hyposensitivity (Ghanizadeh, 2009) or in pitch patterns, dichotic digits or selective auditory attention (Domitz & Schow, 2000). Furthermore, because APD is often comorbid with other disorders, such as behaviour, correct diagnosis is further perplexed. As indicated by Sharma et al. (2009), diagnosis often depends on which specialist is consulted in the first instance, whether it is

auditory or behavioural in nature. It remains unclear, then, whether real gender differences are present in APD, or whether more boys are identified with APD because more boys exhibit externalising problem behaviour. As discussed earlier, sample bias may also account for discrepancies in reported findings.

In sum, APD is often comorbid with behavioural and attentional problems (Rowe & Rowe, 2006), language impairments (Reddy & De Thomas, 2007) and reading difficulties (Moore, 2007). Because of the complex nature of APD and its relationship with other disorders, it is unclear whether gender differences in reading are the result of auditory processing difficulties, or due to attentional, behavioural or language difficulties. The lack of consistency in measures for APD, as well as the scarcity of studies reporting gender, also contributes to discrepant findings. It has been previously reported that the ratio of boys to girls with APD is approximately 2:1, although it has been demonstrated that a number of studies have employed referred samples. On the other hand, others have found no gender differences in APD at all, in either referred or non-referred samples. Evidence suggesting that APD accounts for why there may be more boys than girls with a reading disability, therefore, is minimal.

Problem Behaviour

Another explanation that has been proposed relates to problem behaviour. It is well established that a link between problem behaviour and poor reading exists (Rowe & Rowe, 1999; Smart et al., 2001) and that this link is stronger for boys than for girls (Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006; Willcutt & Pennington, 2000). A number of studies have reported that boys have significantly lower levels of reading ability as well as higher levels of problem behaviour (Fleming, Harachi, Cortes, Abbott, & Catalano, 2004; Skårbrevik, 2002). Evidence also suggests that boys are more likely to display externalising problem behaviour (such as troublesome behaviour or 'acting out'; Beaman et al., 2007) whereas girls are more likely to experience internalising problem behaviour (such as anxiety; Levy, Hay, Bennett, & McStephen, 2005). It remains unclear, however, whether the relationship between reading disability and problem behaviour is merely correlational or causal, and if the latter, the direction of causality (Rowe & Rowe, 1999; Sanson et al., 1996; Spira et al., 2005). This relationship has important implications in determining whether boys' externalising problem behaviour accounts for a greater proportion of boys reported to have a reading disability.

One line of research supports the proposition that problem behaviour leads to later reading disability or poor reading (Hinshaw, 1992). Smart et al. (2001), for example, investigated the degree to which intelligence, early poor reading, early problem behaviour and family factors affected later reading ability. They found that intelligence and early problem behaviour contributed to later poor reading for boys, but not for girls. This suggests that boy's poor reading, and subsequent gender differences in reading ability, may be partly a result of problem behaviour.

On the other hand, there is also evidence to suggest that poor reading leads to problem behaviour, especially for boys. For example, Bennett, Brown, Boyle, Racine, and Offord (2003) assessed a large random sample of kindergarten and Grade 1 students on the Ontario Child Health Study-Revised scales for conduct disorder, as well as reading using the Wide Range Achievement Test (WRAT). They evaluated reading ability at school entry, and assessed behaviour approximately 30 months later, concluding that early poor reading contributed to later problem behaviour. This finding would suggest that gender differences in problem behaviour do not account for gender differences in

poor reading. Instead, boys' problem behaviour may be the result, not the cause, of poor reading. Evidence suggests there may be nearly as many girls who are poor readers, but because girls' problem behaviour tends to be more internalised, and therefore less disruptive, they are less likely to be identified (Bauermeister et al., 2007; Biederman et al., 2005; Levy et al., 2005).

A third view hypothesises that problem behaviour and poor reading cause each other (Morgan, Farkas, Tufis, & Sperling, 2008). In a recent longitudinal study, Trzesniewski et al. (2006) assessed a large sample of twins on the Test of Word Reading Efficiency (TOWRE) as well as measures of conduct disorder and antisocial behaviour. They found that poor reading at age 5 years led to problem behaviour at age 7 years, and vice versa. For girls, however, while problem behaviour at age 5 years led to poor reading at 7 years, poor reading did not lead to later externalising problem behaviour. If the relationship between problem behaviour and poor reading is reciprocal, this would indicate that while problem behaviour may play a significant role in poor reading, the extent to which it accounts for gender differences in poor reading remains unclear. It is also worth noting that behaviour and reading problems may be a result of the 'Matthew Effect' (McIntosh, Horner, Chard, Dickey, & Braun, 2008; Morgan et al., 2008), where students who are poor readers, or display problem behaviour, fall even further behind (McIntosh et al., 2008). Good readers, on the other hand, tend to read more and become even better readers, and therefore the gap widens between good and poor readers.

Based on current research on behaviour and reading problems, interventions can vary depending on whether problem behaviour is thought to precede reading problems, or vice versa (Morgan et al., 2008). Overall, however, a number of researchers agree that successful intervention should target both problem behaviour and reading difficulties simultaneously (Bennett et al., 2003; Morgan et al., 2008), particularly for boys (Trzesniewski et al., 2006). Additionally, despite the fact that behaviour problems and reading problems are distinctly different disorders (de Jong, Oosterlaan, & Sergeant, 2006), breakthroughs in neurological research suggest that attention, as a cognitive process in the brain, also plays a role in reading problems. Shaywitz and Shaywitz (2008) have suggested that interventions for behaviour problems or ADHD, then, may also benefit poor reading or dyslexia.

Aside from the debate as to whether problem behaviour causes poor reading or vice versa, a further line of research suggests that boys' problem behaviour does not account for gender differences in poor reading, but instead accounts for gender differences in the number of boys identified as poor readers. Studies show that boys' externalising behaviour hastens more frequent referrals to special education services, and therefore more boys than girls are identified as poor readers. Because many studies employ referred samples, it has been assumed that many more boys have reading problems (Hawke et al., 2007; Liederman et al., 2005; Shaywitz et al., 1990). Conversely, a number of studies have demonstrated that while they found significant gender differences in problem behaviour, they did not find significant gender differences in reading. Smart et al. (2001), for example, examined reading comprehension and behaviour longitudinally at 7–8 years and then at 13–14 years. They found no significant gender differences in reading comprehension or spelling at 13–14 years, with minimal gender differences in improvement rates. On the other hand, significantly more boys were reported by teachers and parents as high risk for behaviour problems. In addition, while externalising problem behaviour did affect reading and spelling, intelligence and socioeconomic status were factors more likely to influence achievement.

Sanson et al. (1996) conducted a large longitudinal study from birth to 6 years, examining measures of reading (such as reading comprehension and vocabulary) as well as behaviour. Overall, nonsignificant gender differences were found in reading, but significant gender differences were found in problem behaviour. Sanson et al. concluded that although there were no gender differences in the frequency of reading disability, more boys were identified as having a reading disability due to a higher co-occurrence of behaviour problems. Other studies have reported similar findings (see, e.g., Matthews, Ponitz, & Morrison, 2009; Willcutt & Pennington, 2000). Collectively, these findings indicate that problem behaviour does not account for gender differences in reading, but instead accounts for a greater prevalence of boys identified as poor readers.

Although problem behaviour and poor reading are frequently comorbid, it remains unclear whether the relationship between problem behaviour and poor reading is causal, correlational or even reciprocal. Evidence suggests that significantly more boys than girls are identified as having externalising problem behaviour, but whether this behaviour accounts for gender differences in poor reading remains unresolved. The fact that the majority of studies focus on boys, and few studies have examined problem behaviour and poor reading for girls, further complicates the issue. A growing body of evidence suggests that the greater prevalence of boys identified as poor readers is due to sample selection rather than to actual gender differences in reading skills. While the nature of this relationship continues to be debated, one thing is clear: irrespective of gender differences in reading skills, more boys are identified as poor readers as a result of problem behaviour.

Neurology

A further explanation to account for more boys than girls identified as having a reading disability is neurological in origin. In recent years, neurological research into reading has been considerably advanced by using brain imaging techniques, such as functional magnetic resonance imaging (fMRI; Hudson, High, & Al Otaiba, 2007), a technique which measures blood flow in areas of the brain (Shaywitz & Shaywitz, 2007). Severe reading disability, or dyslexia, is considered to be neurological in origin (Hudson et al., 2007). The human brain is divided into right and left hemispheres, where different regions or lobes within these hemispheres are responsible for different reading and reading-related activities. For example, it is thought that the frontal lobe controls speech, the parietal lobe controls spoken and written language and is linked with memory, the occipital lobe controls vision, which can identify letters, and the temporal lobe controls verbal memory (Hudson et al., 2007). Two additional areas of importance are the left parietotemporal system (involved in word analysis, decoding, and comprehension) and the left occitotemporal area (involved in automatic access to whole words and fluent reading; Hudson et al., 2007; Shaywitz et al., 2004). Different reading and reading-related activities therefore activate different regions in the brain. There is evidence to suggest, however, that people with reading difficulties exhibit different brain activation patterns to those who are normal readers (Shaywitz & Shaywitz, 2008).

In terms of gender, evidence suggests that boys are more brain lateralised than girls, and display a greater left lateralisation in reading and reading-related tasks (Boles, 2005; Coney, 2002; Phillips et al., 2001). Girls, on the other hand, display greater bilaterality (Kansaku, Yamaura, & Kitazawa, 2000; Shaywitz et al., 1995; Wallentin, 2009). These gender differences have been observed in passive-listening tasks (Phillips et al., 2001), phonological tasks (Coney, 2002; Shaywitz et al., 1995), and grammatical tasks (Jaeger et al., 1998).

Some neurological studies have reported that gender differences in reading ability may depend on the task undertaken. In other words, neurological differences between boys and girls may be task specific. Pugh et al. (1996) found that men displayed greater brain activation with semantic tasks, compared to phonological tasks, but women displayed no differences in brain activation between semantic and phonological tasks. Burman, Bitan, and Booth (2008) demonstrated that, on language tasks such as spelling and rhyming, boys activated different parts of the brain depending on whether the task was presented visually or auditorily. Task accuracy also depended on modality of presentation. Girls, on the other hand, activated the same part of the brain regardless of whether the task was visual or auditorily. Burman et al. concluded that boys and girls use different parts of the brain to process the same task. In a similar vein, Clements et al. (2006) found that boys appear more left lateralised than girls on phonological tasks, and bilateral for visuospatial tasks. Conversely, girls are more bilateral for phonological tasks and right lateralised on visuospatial tasks.

Gender differences in reading are also evident according to task complexity. Jaeger et al. (1998) found significant gender differences in the pattern of brain activity depending on the complexity of the task. While both men and women displayed bilateral patterns of activation during a simple reading task (reading aloud verbs and regular words), only men showed greater left hemisphere laterality for a complex task (speaking past tense of regular verbs, irregular verbs and nonce verbs). Conversely, women were more bilaterally activated during both complex and simple tasks. Gender differences emerged as the complexity of the task increased. Others have also identified gender differences according to task difficulty (Gur et al., 2000).

While many neurological studies provide data on the efficacy of intervention, very few studies to date explore intervention specifically for boys. Burman et al. (2008), for example, indicated that boys may benefit from an improvement in sensory processing, given that task accuracy depended on the modality of word presentation (visual vs. auditory). Shaywitz and Shaywitz (2008), on the other hand, suggest that there is a link between the inferior parietal cortex, attention, and reading, and conclude that attention (and disruption) is a causal factor for reading difficulties. It is possible, then, that intervention may lie in the treatment for behavioural problems such as ADHD. Although their study was not gender-specific, as discussed in the previous section it is well established that behavioural problems are more common in boys than in girls (Shaywitz et al., 1990; Willcutt & Pennington, 2000).

While there is a considerable body of neurological evidence to support gender differences in reading, there are likewise numerous studies demonstrating little or no significant differences. Molfese et al. (2006) suggested that while there were differences in the brain between boys and girls, there were no differences related to reading. Wallentin (2009) reviewed a number of studies on lateralised behaviour, including language tasks (recalling one-syllable words) and response time, and there were no significant differences reported. Wallentin also concluded that gender was not a significant predictor in verbal fluency, despite acknowledging that verbal fluency was one of the most cited tasks in the literature for demonstrating gender differences. Sommer, Aleman, Somers, Boks, and Kahn (2008) also reported no gender differences in verbal fluency, verb generation, and language comprehension tasks. Shaywitz et al. (1995), while reporting significant gender differences in phonological tasks, found no significant differences between boys and girls in orthographic and semantic tasks.

Boles (2005) demonstrated that gender accounts for only 0.09% to 1.0% of variability across a number of tasks, and concluded that a greater variability in

performance can be evidenced within the gender groups rather than between them. As a result, gender (as a variable) appears to have little predictive value. In a similar vein, Molfese et al. (2006) found that boys and girls responded to reading tasks in similar ways, and concluded that 'as far as a reading deficit is concerned, the impact on boys and girls will be the same' (p. 361).

Neurological research on gender differences in reading has rapidly grown over the past decade, although reported findings have been somewhat mixed. It is possible that differences in neurological imaging techniques may account for differences in reported findings; likewise, differences in the types of tasks and task complexity also vary considerably between studies (Clements et al., 2006). Variability has also been identified among studies in relation to the reading skills that are actually measured (e.g., phonological, semantic, comprehension tasks; Clements et al., 2006). Age is another factor that may affect results (Shaywitz & Shaywitz, 2007), particularly if, as has been suggested, girls often have superior language from an earlier age (Burman et al., 2008). It is difficult to ascertain, therefore, whether any differences in the brain between boys and girls are significant in reading and reading-related tasks, and therefore account for the observed preponderance of boys with a reading disability, or whether reported gender differences are the result of methodological variability among studies (Kaiser, Haller, Schmitz, & Nitsch, 2009).

Variance in Cognitive Ability

A further explanation hypothesised to account for why there may be more boys than girls with a reading disability relates to observed gender differences in cognitive abilities. Gender differences in cognitive abilities have been a topic of interest for more than one hundred years (Ellis, 1894; Thorndike, 1914). Although relatively small gender differences have been reported in overall intelligence scores over the years (Colom, Juan-Espinosa, Abad, & García, 2000; Deary, Thorpe, Wilson, Starr, & Whalley, 2003; Galsworthy, Dionne, Dale, & Plomin, 2000), a number of studies have demonstrated gender differences within specific cognitive abilities (Halpern & LaMay, 2000; Johnson, & Bouchard, 2007). Boys have reportedly been superior in spatial abilities (Voyer, Voyer, & Bryden, 1995), whereas girls have scored higher on verbal abilities (Halpern & LaMay, 2000; Vogel, 1990), although such differences have been inconsistent throughout the literature (see, e.g., Hyde & Linn, 1988).

Gender differences have also been reported in the variability of scores in cognitive abilities (Dykiert, Gale, & Deary, 2009). Boys tend to demonstrate greater variability than girls in scores on cognitive ability measures, resulting in an over-representation of boys at the extreme ends of the distribution (Lohman & Lakin, 2009). Boys have been shown to display greater variability on verbal, quantitative, and nonverbal abilities (Strand, Deary, & Smith, 2006). Girls, on the other hand, show smaller variations in cognitive ability scores, and therefore cluster more closely around the mean (Lynn & Mikk, 2009). For example, Strand et al. (2006) conducted a large study in the United Kingdom, employing more than 320,000 students aged 11–12 years. By performance on the Cognitive Abilities Test (CAT), Strand et al. demonstrated that boys' scores were more variable than girls' scores on all three cognitive abilities measured (verbal, quantitative, and non-verbal reasoning). More boys than girls were represented in the top and bottom ends of the distributions. Recently, Lohman and Lakin (2009) replicated Strand et al.'s study in the United States, analysing student performance on the CogAT, an American version of the CAT, for a sample of 318,599 students between grades 3 to 11. Confirming Strand et al.'s findings, Lohman and

Lakin also reported greater variability in scores for boys. This greater variability for boys may explain why there are many more boys identified as gifted or with a learning or intellectual disability (Deary et al., 2003).

There is growing evidence to suggest that boys' variability is not limited to cognitive abilities, but rather is manifest across a wide range of abilities, including reading. Emerging research indicates that boys display greater variability than girls in reading scores, which in turn results in more boys being represented in the tail of the distribution. As a consequence, more boys are identified as having a reading disability (Hawke, Olson, Willcutt, Wadsworth, & DeFries, 2009). In a recent study, Hawke et al. (2009) demonstrated greater male variance in reading scores in a large twin study. Two groups of twins (one group with reading disability, one group without) were assessed on the Peabody Individual Achievement Test (PIAT), which included measures of reading recognition, reading comprehension, and spelling. In the reading difficulty group, boys' scores were significantly more variable on all three measures; in the non-reading difficulty group, male variance was significantly greater for reading comprehension and spelling, but not reading recognition (recognising printed words and reading words aloud). Hawke et al. concluded that greater male variance is related to gender differences in reading recognition, reading comprehension and spelling.

Others have reported similar findings. Machin and Pekkarinen (2008) examined gender differences in reading scores for the 2003 Programme for International Student Assessment (PISA), in which 15-year-old students across 41 countries participated. Reading ability in the PISA has been shown to be equivalent to the verbal comprehension component in intelligence testing (Lynn & Mikk, 2009). Boys' reading scores were significantly more variable than girls' scores and this result was robust across all countries. Lynn and Mikk (2009) also examined reading scores on the PISA for the years 2000, 2003 and 2006, as well as results for two Progress in International Reading Literacy Studies (PIRLS) for 2001 and 2006. By performance on the PISA, boys displayed significantly greater variance in reading across all countries. Greater variance for boys was also evidenced in both PIRLS studies. In 2006, for instance, the variance for boys' scores was greater than girls' scores by 8%. Others have found similar gender differences for variance in reading scores, even though differences in overall means between boys and girls were not statistically significant (Reynolds et al., 1996). Similar patterns in means and distributions are likewise evident in writing, mathematics and science (see, e.g., Nowell & Hedges, 1998). The fact that greater male variance in scores is seen in a number of academic areas, as well as cognitive abilities, indicates that greater variance in reading scores may be part of a larger phenomenon.

While there is evidence to suggest that gender differences in variance on cognitive abilities might explain observed gender differences in reading disability numbers, others have disputed the view that intelligence has much influence on reading acquisition (Siegel & Smythe, 2005). Throughout the literature one of the most used methods of identifying poor readers has been discrepancy formulae, which is premised on the assumption that reading ability can be predicted by performance on intelligence tests. Emerging evidence suggests, however, that this method of identification is not only illogical, but flawed (Siegel & Smythe, 2005). As indicated by Siegel and Smythe (2005), intelligence tests do not measure skills critical to reading, such as fluency and accuracy. Similar conclusions have also been reached by others (O'Malley, Francis, Foorman, Fletcher, & Swank, 2002; Stanovich, 1999). Furthermore, research indicates that there is little cognitive difference between low-progress readers and those identified as having a reading disability by discrepancy methods (Fletcher et al., 1994; O'Malley et al., 2002;

Stanovich, 1999). As indicated by Stanovich (1999), there is also no evidence to suggest response to remediation differs according to intelligence.

Others have reported that cognitive ability, or intelligence, does not wholly explain gender gaps in reading. Although girls have been shown to score higher on measures of verbal cognitive ability, gender only accounts for approximately 3% of variance (Galsworthy et al., 2000). Furthermore, Strand et al. (2006) indicated that cognitive abilities, such as reasoning, are strongly associated with educational attainment, particularly in English. Although boys' scores in reasoning were significantly more variable than girls, this variability could not fully account for the considerably larger gender gaps found in national assessments, particularly at the bottom end of the distribution. Additionally, Strand et al. indicated that factors such as socioeconomic status account for considerably more variance in scores compared to gender, which is extremely small. This conclusion is supported elsewhere (Fluss et al., 2009).

Finally, it should be noted that the majority of studies on cognitive abilities have largely focused on means rather than variances (Lohman & Lakin, 2009); likewise, the same is true for studies in gender differences in reading. The hypothesis that boys' variance in cognitive abilities may account for a greater prevalence of boys identified with reading problems remains largely unexplored. Potentially erroneous conclusions regarding gender differences in reading, however, may arise in the absence of widespread research. For example, in a large meta-analysis, Hyde (2005) proposed the gender similarities hypothesis, where boys and girls are more alike than different for a range of cognitive and educational abilities. Across a number of studies examining reading comprehension, vocabulary, verbal reasoning and language, among other skills, Hyde reported very small effect sizes and concluded that gender differences were minimal, and varied depending on the context. Lohman and Lakkin (2009) also reported small effect sizes for gender mean differences. When they further analysed the data, however, they found significant gender differences in the variability of scores. Lohman and Lakin indicated that had they limited their analysis to differences in means (which were minimal), and not explored gender differences in variances (which were significant), they would have drawn very different conclusions.

There is evidence to suggest that the greater variability in boys' cognitive abilities accounts for a greater preponderance of boys with reading disability. Conversely, others have found that the influence of intelligence on reading acquisition is generally regarded as not a critical factor. Despite the fact that intelligence is not a precursor to reading ability, and the fact that it has been demonstrated that boys' show greater variability in scores across a range of cognitive and educational domains, it appears that boys' greater variability in reading scores is part of a larger phenomenon. This greater variability in reading scores, then, may account for why more boys have been identified as having a reading disability. Given the scarcity of studies exploring this trend, however, more research is needed to investigate the validity of this explanation.

Motivation for Reading

A final explanation in this review relates to gender differences in motivation for reading. It is well established that motivation plays an important role in reading achievement (Aarnoutse & Schellings, 2003; Martin, 2003; Mucherah & Yoder, 2008), and is critical in the development of literacy skills (Meece & Miller, 2001). Motivation has been previously defined in a number of ways, such as a drive to learn (Martin, 2003), a positive attitude towards reading (Baker & Wigfield, 1999), and a focus on beliefs, goals

and values (Wigfield, 1997). Motivation is multidimensional by nature (Martin, 2003; Coddington & Guthrie, 2009), involving aspects of intrinsic and extrinsic goals, self-efficacy and social aspects of motivation (Mucherah & Yoder, 2008); task mastery (Meece & Miller, 2001), attribution styles (Meece, Bower Glienke, & Burg, 2006); and value of schooling and learning focus (Martin, 2003). Many other facets of motivation have also been identified (see, e.g., Baker & Wigfield, 1999; Martin, 2003; Meece et al., 2006; Wigfield & Guthrie, 1995). Motivation can be general or domain specific, vary according to age and years of schooling, and change depending on motivational goals (Meece & Miller, 2001). Struggling readers are often low in dimensions of motivation, including self-efficacy and confidence, and are more likely to display work-avoidant or self-handicapping strategies (Guthrie & Davis, 2003).

A number of studies have demonstrated gender differences in reading motivation, where girls have an overall higher motivation for reading than boys (Kelley & Decker, 2009; Lepola, 2004; Mucherah & Yoder, 2008). Martin (2004) found that boys are more negative towards school, whereas girls have a greater reading enjoyment, reading pleasure and enjoy talking about books. Others have also reported that girls place a higher value on reading than boys do (Baker & Wigfield, 1999). It remains unclear, however, whether the relationship between reading and motivation is causal or correlational. In other words, are girls better readers because they have higher levels of motivation, or vice versa? Reviewing the evidence on gender differences in motivation and reading, therefore, should be viewed with consideration of this question.

In a recent review, Meece et al. (2006) examined gender differences in motivation across a range of educational domains, including reading. Four theories of motivation were discussed, including attribution, expectancy-value, self-efficacy, and goal theories. There were few gender differences in motivation according to theories of attribution and goal orientations. For expectancy-value theories (including competency beliefs and value beliefs), boys and girls commence school with similar ability beliefs, but boys decline more rapidly in their ability beliefs over the years. In terms of value, girls place greater emphasis on reading, whereas boys tend to value sports. According to the self-efficacy theory of motivation, gender differences relate to age and grade of students. For example, in primary school years, effect sizes for gender differences in motivation were very small (0.09), whereas effect sizes were considerably larger for high school (0.66). Meece et al. also indicated that results in this study were also moderated by socioeconomic status and ethnicity.

Others have also reported small gender differences in reading motivation. Kelley and Decker (2009), for example, found that although girls had a significantly higher motivation for reading than boys, gender only accounted for 3% of the variance in reading motivation. Additionally, girls were found to value reading significantly more than boys, but overall only 4% of variance in motivation was accounted for by gender. Self-concept, on the other hand, accounted for 52% of students' motivation to read, and value of reading accounted for 48% of variance. Conversely, effect sizes for gender were very small. It should be noted, however, that this study examined student-reported levels of reading motivation on the Motivation to Read Profile (MRP) Survey, and did not include data on actual reading performance.

On the other hand, several studies have reported reading motivation as well as reading performance by gender. Mucherah and Yoder (2008), for example, examined reading motivation, as well as reading by performance on the Indiana Statewide Testing for Educational Progress (ISTEP+), for 388 middle school students. Using the Motivation for Reading Questionnaire (MRQ; see Wigfield & Guthrie, 1997), 11 aspects

of motivation were examined: reading efficacy, reading challenge, reading curiosity, aesthetic enjoyment, importance, reading work avoidance, competition in reading, recognition for reading, reading for grades, social reasons for reading, and compliance. Results showed that girls were significantly higher in social reasons for reading, reading for grades, compliance, and importance. Girls also had higher reading efficacy and read more challenging material compared to boys. Mucherah and Yoder found that reading efficacy, reading challenge, reading for aesthetic enjoyment and reading for social reasons were significant predictors of performance on the ISTEP+.

Gender differences in reading performance have also been found in regard to reading activity and reading preferences. Baker and Wigfield (1999) examined the relationship between motivation, reading achievement, and reading activity (i.e., reading a book for fun). Using the MRQ, significant correlations were found between reading achievement and motivation for girls, but not for boys: girls were higher in compliance (reading to meeting others' expectations), recognition (reading for tangible recognition) and reading for grades. Boys, on the other hand, scored higher in work avoidance (desire to avoid reading) and competition (desire to outperform others). Topping, Samuels, and Paul (2008) explored gender differences in preference for fiction and non-fiction reading on a sample of 45,670 students. Boys tended to read less often than girls, and preferred non-fiction to fiction books. Girls, on the other hand, demonstrated both higher reading quality and quantity than boys, and read more fiction. Effect sizes for gender differences in reading achievement, however, were small across grades, ranging from -0.005 to 0.134.

While there are a number of interventions for increasing boys' general academic motivation (see, e.g., Martin, 2003, 2004), few studies focusing on reading advocate interventions specifically for boys. Interventions for increasing reading motivation, regardless of gender, should focus on increasing the aspects of motivation correlated to reading success. Research indicates that girls are higher in self-efficacy and reading more challenging material, and these aspects of motivation are strong predictors of performance on standardised reading tests (Mucherah & Yoder, 2008). Reading programs for boys, then, might aim to increase self-efficacy and encourage the reading of more challenging material, appropriately selected (Topping et al., 2008). Such programs, however, would also be beneficial for poorly motivated girls. While the nature of the relationship between reading and motivation remains unclear, the design of interventions could focus on improving both. Finally, research suggests that both boys and girls might benefit from programs designed to increase intrinsic motivation in reading (Guthrie & Davis, 2003). A number of studies have demonstrated how programs that increase reading involvement also increase performance on comprehension tests (Mucherah & Yoder, 2008). Reading programs that increase extrinsic motivation are also beneficial, but limited: once the reward for reading improvement is removed, the interest in reading declines (Mucherah & Yoder, 2008).

Reading achievement is strongly correlated with reading motivation (Mucherah & Yoder, 2008), and studies show that girls have higher levels of motivation for reading than boys (Baker & Wigfield, 1999; Lepola, 2004), although gender has been shown to account for only a small percent of variance. Girls often score higher in aspects of motivation such as self-efficacy, reading challenging material, and competency beliefs, which are often linked to reading success. It is not clear whether levels of reading motivation precede reading ability or vice versa, therefore the degree to which motivation accounts for more boys than girls observed to have a reading disability is uncertain. More research is needed to clarify the relationship between motivation and reading.

Conclusion

Throughout the literature it has been repeatedly demonstrated that girls outperform boys on measures of reading, and that there are more boys than girls who struggle with reading or have a reading disability. A number of theoretical explanations have been proposed to account for these reported gender differences in reading, including phonological awareness, auditory processing, behaviour, neurology, variability in cognitive ability scores, and motivation. From a review of empirically based evidence, it does not appear that any single explanation wholly accounts for gender differences in reading ability, and that gender, as a variable, is not a strong or consistent predictor of reading success.

Phonological awareness is one of the strongest predictors of reading ability, accounting for up to 54% of variability (Singleton et al., 1999), but there is minimal evidence suggesting that phonological awareness, or phonemic awareness, accounts for gender differences in reading. The majority of available research on phonemic awareness did not report gender at all, but based on the minimal evidence at hand, gender differences were evident depending on the nature and complexity of the task. These differences, however, did not consistently lead to gender differences in reading outcomes. Although significant gender differences in phonemic awareness have been reported across a number of studies, these same studies also conceded that differences were very small. Other studies found no differences in phonemic awareness between boys and girls. Likewise, evidence suggesting that auditory processing accounts for gender differences in reading is sparse. Studies that do report differences between boys and girls appear to rely on referred samples.

In terms of behaviour, there are consistently significant gender differences in problem behaviour, and although problem behaviour and poor reading are comorbid more often than chance (Knivsberg & Andreassen, 2008), this does not always translate to gender differences in reading ability. Similarly, it remains unclear whether the relationship between poor reading and problem behaviour are causal, correlational or reciprocal (Spira et al., 2005). Problem behaviour in itself, however, does contribute to the fact that significantly more boys than girls are referred for special education services.

In terms of neurological explanations, similar to the findings for phonemic awareness and auditory processing, the majority of studies do not report results by gender. Among those that did report gender, differences between boys and girls were found according to the complexity and nature of the task at hand, although this did not consistently affect reading outcomes. While some studies reported significant gender differences, others did not. According to neurological explanations for differences in reading, it does not appear that gender is a strong predictor of reading success. Boles (2005), for example, reported that gender only accounted for 0.09% to 1% of the variance.

In terms of cognitive variance, evidence suggests that boys have greater variability in scores than girls across a range of cognitive and educational domains, including reading. Greater male variability in reading scores, then, appears to be part of a larger phenomenon, and not necessarily a result of variability in cognitive ability. It is plausible that more boys are identified as poor readers as a result of their extreme scores, but because the majority of studies focus on means rather than variances, more research is needed in order to establish the validity of this explanation.

Finally, motivation is a factor that has been shown to be significantly correlated to reading success (Mucherah & Yoder, 2008), but the evidence suggesting that motivation accounted for gender differences in reading success was mixed. A number of studies demonstrated that girls have an overall higher level of reading motivation, and that boys

and girls have different strengths and weaknesses in aspects of motivation. It was not clear, however, whether gender differences in reading were due to gender differences in motivation, or vice versa. More research on the nature of the relationship between reading and motivation is clearly needed in order to draw substantive conclusions.

Based on the findings in this review, two key conclusions can be drawn. First, it does not appear that any single explanation accounts for the observed preponderance of boys identified as having a reading disability. Each explanation clearly has some merit and plays a role in successful reading. All students, for instance, would benefit from a sound knowledge of phonemic awareness, positive behaviour and attention, and an intrinsic motivation for reading. Although these factors are related to successful reading outcomes, they do not consistently explain gender differences in reading outcomes, particularly when evidence supporting gender differences is sparse. Additionally, while there are studies to support the validity of each argument, there are also studies that provide evidence to the contrary.

A second conclusion to be drawn is that gender does not appear to be a strong or consistent predictor of reading outcomes. Across the six explanations discussed, gender has been shown to account for a very small percentage of variance in reading, compared to other factors such as socioeconomic status (Fluss et al., 2009; Strand et al., 2006). Indeed, it has been previously reported that there is sometimes greater variance evident within sex groups, than between sex groups (Boles, 2005; Strand et al., 2006). It may be beneficial, then, for future interventions to be based on aspects of reading which are known to correlate highly with successful reading, focusing on reading outcomes for all students regardless of gender. For example, phonological awareness is one of the strongest predictors of reading ability and accounts for a significant proportion of variance in reading ability (Singleton et al., 1999). Similarly, it has been demonstrated to be a domain of gender-equivalence rather than gender-difference (Savage & Carless, 2004), and therefore separate interventions for boys and girls are not warranted. Research has shown that boys and girls are equally responsive to intervention (Linklater et al., 2009). In addition, because problem behaviour is often comorbid with poor reading, it may also be feasible for future interventions to address issues of behaviour management. While it is not known whether the relationship between problem behaviour and poor reading is causal, correlational or reciprocal, it is generally agreed that intervention should target both behaviour and reading. Successful behaviour strategies may not only benefit poor reading, but may also assist in reducing boys' more frequent referral to special education services, subsequently dispelling the myth that poor reading is a predominantly male phenomenon (Smart et al., 2001). Furthermore, if boys' externalising problem behaviour is reduced, then girls who are struggling readers may have a greater chance of being properly identified. Increasing reading motivation may also be beneficial, particularly in self-efficacy and reading more challenging material. Finally, from a neurological point of view, emerging evidence suggests that although behaviour and reading problems are distinctly different disorders, they access similar regions of the brain and therefore may benefit from similar interventions.

The findings in this review are confounded by a number of variables. Sample selection and bias, for example, may have affected the outcomes of studies reviewed across explanations. As indicated by Smart et al. (2001), in recent decades a considerable number of studies have employed referred samples, where there are up to four times as many boys as girls (Shaywitz et al., 1990). The use of referred samples rather than population samples has resulted in the assumption that poor reading is more a male phenomenon (Smart et al., 2001). Others have reached similar conclusions (Shaywitz et al., 1990). Second,

publication bias and non-reporting of nonsignificant results (Wallentin, 2009) should also be considered when drawing conclusions. The majority of studies on phonemic awareness, auditory processing and neurological processing, for example, do not report results by gender, raising the question of whether gender differences are not evident and therefore not reported, or whether there is an alternative explanation. It further demonstrates that the belief that reading disability is more likely to be a male phenomenon might be based on assumption rather than empirical evidence. Additionally, of the few studies that do report gender, it remains questionable whether the results are representative enough, or significant enough, to draw realistic conclusions.

A final point to consider is that although a number of explanations have been proposed to account for gender differences in reading, the jury is still out as to whether there actually are gender differences in reading. As indicated earlier, some studies have reported little or no differences in reading between boys and girls, where others have reported gender ratios for poor reading up to 4.51:1 (Miles et al., 1998), as a result of differences across studies in assessments, severity of selection, and samples. Wheldall and Limbrick (2010) addressed these inconsistencies by analysing the performance of Years 3 and 5 students on a large-scale assessment over a 10-year period, with a sample of more than one million students. They concluded that although there were more boys than girls who were poor readers, the difference was not as dire as previously thought. Others have reached similar conclusions (Limbrick, Wheldall, & Madelaine, 2010; Siegel & Smythe, 2005). Such findings are also complementary to Hyde's (2005) gender similarities hypothesis. Based on a review of 46 meta-analyses, Hyde concluded that boys and girls are more alike than different in a range of educational and psychological variables, and gender differences have previously been over-inflated. Based on findings in this review, then, it may be that there are differences between boys and girls on various aspects of reading and reading-related factors, but these differences are not as large as previously thought, and do not consistently affect reading outcomes.

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CHAPTER 4: DO MORE BOYS THAN GIRLS HAVE READING PROBLEMS?

Chapter Overview

This Chapter includes an empirical study published in the *Journal of Learning Disabilities* (Wheldall & Limbrick, 2010).

The literature review in the previous chapter (Chapter 3) examined the empirical evidence supporting six of the most common explanations proposed to account for reported gender differences in poor reading. Although these explanations contributed to reading success generally, none could adequately account for differences in the reported proportion of boys and girls identified as poor readers. Conversely, it was found that gender was not a strong or consistent predictor of reading. This is an important finding because it suggests that reported gender differences in poor reading may be more likely to be a result of methodological factors (as indicated in Chapter 2) rather than actual differences between boys and girls. Given the considerable variances in previously reported gender ratios for poor reading, however, the issue still remains as to how best to establish accurate gender ratios for poor reading, particularly in the absence of a universally accepted definition of what it means to be a poor reader. In Chapter 2 it was suggested that a cautious approach may be to employ a method of identification which isolates the tail end of the distribution, taking into account the continuous nature of reading ability (Coltheart & Prior, 2007; Siegel & Smythe, 2005), and administering a standard assessment and severity of selection to a large population sample. Consequently, it was decided to conduct a study that applied this approach.

In the following study, student performance on a large-scale assessment was analysed by gender. Large-scale assessments provide the opportunity of assessing a

population sample on a single measuring of reading, as well as applying a standard severity of selection for defining poor reading. Gender differences in reading using large-scale assessments have previously been identified (Lynn & Mikk, 2009; Machinen & Pekkarinen, 2008), but at the time of this study, gender ratios for poor reading using large-scale assessments had not been reported.

The study reported in the following Chapter examined student performance by gender on the New South Wales Basic Skills Test (BST) across the years 1997 to 2006. The Reading component of the BST was a measure of reading comprehension, and poor reading was defined by two severities of selection, taking into account the continuous nature of reading ability (Siegel & Smythe, 2005). The findings indicated that there are more boys than girls who are poor readers, but there was not the preponderance of boys as previously reported. The proportion of boys identified as poor readers increased with the more stringent severity of selection, confirming the importance of severity of selection when reporting gender ratios for poor reading. This paper contributes to existing research by providing the earliest reported gender ratios for poor reading based on a large-scale assessment.

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CHAPTER 5: ESTIMATING GENDER RATIOS FOR POOR READERS USING LARGE-SCALE ASSESSMENTS

Chapter Overview

This Chapter includes an empirical study published in the *Australian Journal of Education* (Limbrick, Wheldall, & Madelaine, 2010).

The previous chapter (Chapter 4) reported gender ratios for poor reading based on student performance on a large-scale assessment. Using the New South Wales Basic Skills Test (BST), a standard assessment of reading and severities of selection were applied to a population sample. The findings reported in Chapter 4 confirm that there may be more boys than girls identified as poor readers, but there is not a preponderance of boys identified as previously reported (Liederman et al., 2004). This was consistent over a 10-year period. There were more boys than girls in the tail of the distribution and as a result gender ratios varied with severity of selection: gender ratios were higher when a more stringent severity of selection was applied. This is an important finding as it demonstrates that the number of boys identified as poor readers clearly fluctuates depending on the cut-off points for defining poor reading.

In Chapter 4, girls obtained significantly higher means in reading compared to boys, but effect sizes for these differences were not calculated. The size of the difference between boys and girls in reading, then, was unclear. Furthermore, the results presented in Chapter 4 were for New South Wales primary school students only. As each State and Territory in Australia administered its own large-scale assessment prior to 2008, it was difficult to ascertain whether gender ratios in New South Wales were representative of the entire country.

To address these issues, a study was conducted using data on the National Assessment Program – Literacy and Numeracy (NAPLAN), an Australia-wide large-scale assessment introduced in 2008. As the NAPLAN was the first large-scale assessment to assess all students in common grades at the same time, the introduction of the NAPLAN provided the first opportunity to calculate gender ratios for poor reading across Australia. In line with the study reported in Chapter 4, two severities of selection were applied to define poor reading. Findings revealed that there were more boys than girls identified as poor readers, but consistent with the study reported in Chapter 4, there was not a preponderance of boys identified. Effect sizes for gender differences in reading means were calculated, and were found to be consistently low across all grades (Year 3, 5, 7, and 9) and across all Australian States and Territories, indicating that differences between boys and girls in reading were very small despite significant differences in means. Gender ratios for poor performance were also similar for other components of the NAPLAN including writing, spelling, punctuation and grammar, and numeracy. Although it is possible that more boys were identified as poor readers as a result of greater variability in scores, this could not be determined as the standard deviations for boys and girls separately could not be obtained. This study contributes to existing literature, however, by being the first to apply a single definition and measure of poor reading, and calculate gender ratios for poor reading, Australia-wide.

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CHAPTER 6: GENDER DIFFERENCES IN ORAL READING FLUENCY: ARE THERE IMPLICATIONS FOR IDENTIFYING LOW-PROGRESS READERS?

Chapter Overview

This Chapter includes an empirical study accepted for publication in *Special Education Perspectives* (Limbrick, Madelaine, & Wheldall, in press).

The studies reported in Chapters 4 and 5 demonstrate that gender ratios for poor reading can be calculated by performance on large-scale assessments. The advantage of this approach is that a standard assessment of reading and severity of selection can be applied to population sample, thereby offering one possible solution to address the methodological differences across previous studies and subsequently variations in reported gender ratios for poor reading. The average gender ratios reported in Chapters 4 and 5 indicated that there were more boys than girls identified, but gender ratios were relatively low. Effect sizes for differences in means were very small. This is an important finding because it illustrates that differences between boys and girls in reading are comparatively small. It is also consistent with Hyde's (2005) meta-analysis which also found that across a range of cognitive and educational domains, boys and girls are more similar than dissimilar in ability.

Although Chapters 4 and 5 propose that poor readers could be identified by performance on large-scale assessments such as the BST and the NAPLAN, there are limitations. One limitation of this method is that students are only assessed every two years. Studies have shown, however, the importance of early identification and intervention when it comes to reading (Smart et al., 2001). Another limitation is that students are not assessed on a range of reading and related skills, but typically limited to a measure of reading comprehension. It remains unclear, then, whether gender ratios for poor reading

vary depending on the reading skill assessed, or whether boys struggle with different facets of reading more than girls.

In a similar vein, Hawke et al. (2009) suggests that more boys are identified as poor readers due to a greater variability in boys' scores. Hawke et al. reported greater variances in boys' scores on measures of reading recognition, reading comprehension and spelling. Others have reported greater variance in boys' scores in reading comprehension on the Programme for International Student Assessment (PISA). This same pattern was evident in the study reported in Chapter 4, which was also a measure of reading comprehension. It has not been widely investigated, though, whether boys demonstrate greater variability in scores in other critical reading skills, such as oral reading fluency.

Good and Kaminski (2002) state that oral reading fluency is a significant indicator of general reading ability. Oral reading fluency is defined as a number of words read correctly per minute. Its validity as a measure of reading has been repeatedly demonstrated (Madelaine & Wheldall, 2005). Furthermore, measures of oral reading fluency are quick and easy to administer, and can be used to identify low-progress readers (Wheldall & Madelaine, 2005). At the time of this study, there was a gap in the available literature regarding gender and oral reading fluency, particularly reported gender ratios for poor reading based on this skill.

The study in the following Chapter was conducted to ascertain whether there are real gender differences in oral reading fluency, to report gender ratios for poor reading based on this particular reading skill, and determine whether boys demonstrate greater variability in scores in oral reading fluency. In this study, a sample of 210 primary school students (Years 2 to 5) was assessed on measures of oral reading fluency. Participants were

administered the Wheldall Assessment of Reading Passages (WARP) and the Test of Word Reading Efficiency (TOWRE) at three points during the school year (February, May, July). It was found that boys and girls did not significantly differ on either measure, and this was true across the Years 2 to 5. Boys and girls made almost identical gains in oral reading fluency (also please refer to Appendix 1 for additional data which was not included in the article submitted for publication). Given the sample size, however, gender ratios for poor reading could not be calculated. It was concluded that gender is not a strong or consistent predictor of reading in terms of oral reading fluency. This paper contributed to existing literature by providing a unique and comprehensive analysis of the performance of boys and girls in oral reading fluency.

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Pages 168-203 of this thesis have been removed as they contain published material. Please refer to the following citation for details of the article contained in these pages.

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CHAPTER 7: READING AND RELATED SKILLS IN THE EARLY SCHOOL YEARS: ARE BOYS REALLY MORE LIKELY TO STRUGGLE?

Chapter Overview

This Chapter includes an empirical study submitted for publication in a peer-reviewed journal (Limbrick, Wheldall, & Madelaine, 2011c).

The findings reported in the previous Chapters add weight to the idea that differences between boys and girls in reading are not large, and this pattern does not appear to be limited to a particular facet of reading. In Chapter 6, it was found that boys and girls did not significantly differ in mean scores on measures of oral reading fluency, and made almost identical rates of progress. Only very limited evidence for greater variability in boys' scores was found in this facet of reading, however. As gender ratios could not be calculated due to the limited sample size, it could not be determined whether this variability affected the proportion of boys scoring in the tail of the distribution.

The findings that boys and girls did not significantly differ in oral reading fluency are nevertheless valuable because they add further weight to the idea that gender does not appear to be a strong or consistent predictor of reading success across different reading skills. As boys and girls make very similar progress in measures of oral reading fluency, it was evident that boys did not struggle with this facet of reading, at least in the primary school years. What was not addressed in Chapter 4, or the preceding Chapters, is whether boys and girls differ in critical aspects of reading in the early school years. Very few studies to date have examined whether boys and girls differ in various facets of reading in the early school years, or reported gender ratios for poor reading by reading skill.

Furthermore, little research has investigated whether boys demonstrate greater variability in reading scores in early schooling.

The preceding Chapters demonstrated that boys and girls do not appear to have different weaknesses in different reading skills; the study in the following Chapter was conducted to ascertain if this were also true for students in the early school years. It is important to identify whether there are specific reading skills with which boys struggle early on in their school careers as this will have implications for early intervention.

In this study, a sample of 335 students in Years 1 and 2 were administered a wide range of assessments, measuring word and non-word reading skills, phonological recoding ability, phonological awareness, reading fluency, single word verbal ability, and spelling. Poor performance was defined as a score in the bottom 25% of the distribution. Consistent with findings in the middle and upper primary years, early school students did not significantly differ in any facet of reading by gender. There was no facet of reading with which boys struggled more than girls (also please refer to Appendix 2 for additional data which was not included in the article submitted for publication). Boys had slightly greater variability in scores but this did not appear to affect gender ratios for poor reading. Although some research has previously examined gender differences in various aspects of reading in the early school years (Prochnow, Tunmer, Chapman, & Greaney, 2001), this paper contributes to the very limited data on gender differences in the early school years by being the earliest to report on gender ratios for poor performance on individual reading and related measures, and determining to what degree the variability of boys' scores influences gender ratios.

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Reading and Related Skills in the Early School Years: Are Boys Really More Likely to Struggle?

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Abstract

This study examined whether boys and girls in the early school years differed in reading and related skills, and rates of progress. Gender ratios were calculated to ascertain whether there were more boys than girls who struggle with different facets of reading, and whether the variability of boys' scores resulted in more boys identified as poor readers, as evidenced by previous studies. A sample of 335 students in Years 1 and 2 were administered six reading and related assessments. Boys and girls did not significantly differ on any of the measures, and differences in gains were negligible. Boys did not consistently demonstrate significantly greater variability in scores (with the exception of single word reading and spelling in Year 1 only). These differences, however, did not affect gender ratios for poor performance. Gender ratios were relatively low across measures, but increased with years of schooling. Implications of the results are discussed.

Keywords: poor reading, gender, boys, early schooling, gender ratios, variability of scores, severity of selection, rates of progress

Reading and Related Skills in the Early School Years: Are Boys Really More Likely to Struggle?

Gender ratios for poor reading vary considerably throughout the literature and accurately gauging the number of boys and girls who struggle with reading remains a challenge, particularly in the absence of a universally accepted definition of what it means to be a poor reader (Siegel & Smythe, 2005; Stanovich, 1999). Differences across studies in terms of methodological factors may also affect reported gender ratios for poor reading (Limbrick, Wheldall, & Madelaine, 2008). For example, gender ratios for poor reading can vary depending on whether samples are referred or population-based: studies employing population samples have yielded smaller differences in the numbers of boys and girls identified as poor readers (Prior, Sanson, Smart, & Oberklaid, 1995; Shaywitz, Shaywitz, Fletcher, & Escobar, 1990; Siegel & Smythe, 2005). Methods of identification can also inflate gender ratios for poor reading (Prochnow, Tunmer, Chapman, & Greaney, 2001). For instance, regression models using combined data can over-estimate the proportion of boys identified as poor readers (Share & Silva, 2005).

Gender ratios for poor reading can also vary with the severity of selection (cut-off point) for defining poor reading; evidence suggests that because more boys score in the tail of the distribution, more boys are consequently identified as poor readers (Flannery, Liederman, Daly, & Schultz, 2000; Stevenson, 1992). Emerging research suggests that this phenomenon may be due to the fact that boys demonstrate greater variability in scores, rather than girls' superior reading performance (Hawke, Olson, Willcutt, Wadsworth, & DeFries, 2009; Machin & Pekkarinen, 2008). This area of research has, though, focused on reading generally; only very limited research has been conducted on boys' greater

variability in specific aspects of reading, and whether this phenomenon is evident in the early years of schooling (Prochnow et al., 2001).

In a similar vein, few studies have reported gender ratios for poor readers in the early school years (Kindergarten to Year 2/Grade 2). Where ratios have been reported, they have typically related to performance on one or two aspects of reading, such as phonological awareness, reading comprehension, or reading accuracy; few have examined gender ratios across a broad range of reading and related skills. Furthermore, because different studies employ different assessments, and subsequently measure different reading skills, it remains unclear whether variations in reported gender ratios are due to differences in assessment or genuine differences between boys and girls in various facets of reading.

Given the increased attention on boys' educational outcomes in recent years, and the emphasis on closing the reported gender gaps in reading (Baer, Baldi, Ayotte, & Green, 2007; Lynn & Mikk, 2009; Machin & Pekkarinen, 2008; Salahu-Din, Persky, & Miller, 2006), understanding the degree to which boys may be more likely to struggle with reading in the early school years has important implications for future research and remediation. In terms of early intervention, it would be beneficial to identify whether boys and girls have different strengths and weaknesses in different reading and related abilities, so that identified weaknesses can be addressed early on. This would be a considerable advantage over other methods of identification, such as the discrepancy method. One of the criticisms of the discrepancy method is that students often experience years of failure before a discrepancy between actual reading scores, and reading scores predicted from intelligence scores, is reached (Fuchs, Mock, Morgan, & Young, 2003). This may be especially pertinent for boys in the long term, given that gender ratios for poor reading can increase

over time (Aaron, Joshi, Gooden, & Bentum, 2002; Galletly, Knight, Dekkers, & Galletly, 2009). It is also worth identifying whether boys demonstrate greater variability in scores in the early school years to further establish whether any differences between boys and girls are due to gender or methodological factors.

The purpose of this article is to examine briefly the existing literature on gender and reading in the early school years. We will examine previously reported gender ratios for poor reading, and report gender ratios for early poor reading ability for a range of reading and related skills using a population sample. We will also determine whether boys' demonstrate greater variability in scores in specific facets of reading and related skills, and whether this difference in variability affects gender ratios for poor reading. Finally, this study will examine differential rates of gain across gender in the early school years.

It should be acknowledged that throughout the existing literature, the definition of what it means to struggle with reading has varied enormously; terms such as *reading disability, learning disability, specific learning disabilities, poor readers, low achievement* and so forth have been frequently used, and in many instances these terms overlap and are interchangeable (see, for example, Limbrick et al., 2008). Where existing studies are cited in this paper, the terminologies employed in those studies are used. For the purposes of this study, *poor reading* is defined as a score within the lowest 25% of the distribution.

Gender Differences in Early School Reading

Within the considerable body of literature on early schooling, a number of studies have reported that girls demonstrate superior skills, particularly in the area of language (Weindrich, Jennen-Steinmetz, Laucht, Esser, & Schmidt, 1998). In terms of reading, however, the results of empirical research are mixed. A recent study by Below, Skinner,

Fearrington, and Sorrell (2010) reported significant gender differences on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) for a population sample of 169 Kindergarten students, particularly in initial sound fluency, letter naming fluency, phoneme segmentation fluency and nonsense word fluency, albeit with only small effect sizes (ranging from .20 to .30). Chatterji (2006) also reported significant differences using a sample of 2,296 boys and girls in Kindergarten on the ECLS reading assessment. Using random or population samples, others have reported instances where girls in Kindergarten significantly outperform boys in phoneme segmentation skills (Linklater, O'Connor, & Palardy, 2009), girls in Years 2 and 3 outperform boys insight word ability (Galletly et al., 2009), and girls outperform boys in phonological accuracy in the 5-7 years age group (Dodd, Holm, Hua, & Crosbie, 2003).

Conversely, others have found that boys and girls do not significantly differ in aspects of reading, but more boys are identified through methods of referral. Flynn and Rahbar (1994) employed a sample of 708 students in Years 1 and 3, and found that the proportion of boys and girls did not differ when identified by performance on standardised reading tests, however, there were significantly more boys identified by teacher referral. Shaywitz, Shaywitz, Fletcher, and Escobar (1990) reached similar conclusions. They employed a sample of 215 girls and 199 boys across Years 2 and 3, and compared the proportion of students identified by research criteria versus school criteria.

In a study by Prochnow, Tunmer, Chapman, and Greaney (2001) a sample of 123 (72 boys, 51 girls) were assessed on a range of reading and reading related measures over a three-year period. Students were assessed at four different points between the beginning of Year 1 and the end of Year 3 on measures of phonological sensitivity (a phoneme deletion

task), letter-name knowledge, verbal working memory, receptive vocabulary, phonological recoding ability, word recognition (both context free and in connected text), spelling, arithmetic, reading comprehension, reading book level, reading self-concept, academic self-concept and behavioural difficulties (teacher report on the Child Behaviour Checklist). They found no significant gender differences across a range of measures, with the exception of reading self-concept in the middle of Year 3. Prochnow et al. then examined the performance of boys and girls on tasks employed by schools for determining whether students were identified as requiring remediation (Reading Recovery), and reported that there were no statistically significant differences between boys and girls. Twice as many boys, however, were referred for remediation by schools. It was concluded that the higher incidence of referral for boys for remediation was due to externalising behaviour rather than actual gender differences in reading performance.

More recent research concurs with such findings; boys and girls do not differ significantly in reading performance at the beginning of their school career (Entwistle et al., 2007; McCoach, O'Connell, & Levitt, 2006; Savage & Carless, 2004). Non-significant gender differences for students in Kindergarten to Year 2 have been reported in alphabet knowledge and conventions of print (Harper & Pelletier, 2008), oral reading fluency (Speece & Pericola Case, 2001), phonological awareness (Moura, Mezzomo, & Cielo, 2008; Papadopoulos, Spanoudis, & Kendeou, 2009; Phillips et al., 2007; Savage & Carless, 2004; Speece & Pericola Case, 2001), vocabulary and letter-word reading (Matthews, Ponitz, & Morrison, 2009), and reading comprehension (Lepola, 2004; Onatsu-Arvilommi & Nurmi, 2000; Prior et al., 1995).

Evidence is also conflicting in terms of *rates of progress*, or *gains*, for boys and girls. On the one hand, significant gender differences have been reported in the early school years. Girls have demonstrated superior gains in phonological awareness (Moura et al., 2008), initial sound fluency and phoneme segmentation fluency (Linklater et al., 2009), whereas boys have demonstrated higher gains in combined phoneme segmentation tasks (Linklater et al., 2009). On the other hand, studies have also shown that boys and girls do *not* differ in mean gains in the early school years in oral reading fluency (Below et al., 2010; Chard et al., 2008; Wang et al., 2008). Likewise, McCoach et al. (2006) found no statistically significant gender differences in gains in letter recognition, word reading, vocabulary and reading comprehension.

Inconsistencies across studies in terms of gender differences and rates of progress in early schooling are likely, to some degree, be the result of differences in factors such as sample selection and severity of selection, but are also confounded by variations in the actual reading skills measured. For instance, within the existing literature on early schooling, very few studies have examined a range of reading skills within a single sample (Prochnow et al., 2001). More frequently, however, studies address specific areas of reading, such as oral reading fluency (Below et al., 2010; Wang et al., 2008), phonological awareness (Moura et al., 2008; Papadopoulos et al., 2009; Savage & Carless, 2004; Savage et al., 2007) or sight words and decoding (Galletly et al., 2009). Others have addressed a limited range of reading skills. Speece and Pericola-Case (2001) administered assessments in oral reading fluency, word attack skills, and phonological processing. Lepola (2004) addressed phonological awareness, word recognition and reading comprehension. Hirvonen, Georgiou, Lerkkanen, Aunola, and Nurmi (2009) examined phonological

awareness, oral reading fluency, spelling and comprehension. Given that so few studies have examined gender differences across a range of reading and related measures, or applied different combinations of assessments have been previously administered to different samples, it is unclear whether reported gender differences vary across studies because of differences in assessment, or whether there are genuine differences between boys and girls in various facets of reading.

Gender Ratios for Poor Reading in Early Schooling

To date few studies appear to have explicitly reported gender ratios for poor readers in the early school years, but gender ratios may be calculated based on the information provided in some studies (for example, where the number or percentage of boys and girls identified as poor readers is reported, a gender ratio can be calculated by dividing the number of boys by the number of girls). These reported gender ratios, however, are difficult to compare given differences across studies in the definition and assessment of poor reading. For instance, Prior et al. (1995) used the term *reading disability*, defined as a score of more than one Standard Deviation below the mean on the Australian Council for Educational Research (ACER) Word Knowledge Test (ACER, 1969), which assesses "decoding and comprehension of the meaning of common words" (p.33). Based on this definition, gender ratios for a sample of 195 Year 2 students were approximately 1.2:1 (56% boys, 44% girls). Prochnow et al. (2001) employed the term *poor reader*. They reported gender ratios for poor reading as 2:1 based on teacher referral, although there were no statistically significant differences between boys and girls on assessments used for identification. More recently, Galletly et al. (2009) defined *low achievement* as a Standard Score of <90 on subsets of the Test of Word Reading Efficiency (TOWRE) (Torgesen et

al., 1999). Galletly assessed 1,205 students on the TOWRE Sight Word and Phonemic Decoding subtests, by year of schooling (Years 2-3, 5-6 and 7-8). Based on their findings, gender ratios for Years 2 and 3 students (combined) were 1.44:1 (14.1% boys, 9.8% girls) for Sight Words, and 0.95:1 (9.9% boys, 10.4% girls) for Phonemic Decoding.

Speece and Pericola Case (2001) applied three methods to identify *poor reading* or *reading difficulty*, being: Curriculum-Based Measure of Reading (CBM) Dual Discrepancy model (regression was used to calculate the slope of performance in oral reading fluency, and poor performance was defined as more than 1 Standard Deviation below the slope); an IQ-Discrepancy model (regression of Woodcock-Johnston-Revised Basic Reading Scores Cluster on FSIQ scores, and poor performance defined as predicted achievement >1.5 Standard Errors of prediction); and a Low Achievement model (poor performance was 1 Standard Score <90 on the WJ-R). From a sample of 694 students in Years 1 and 2, gender ratios for poor reading could be calculated for each method: 1.04:1 (24 boys, 23 girls) for a CBM-Dual Discrepancy model, 1.12:1 (9 boys, 8 girls) for an IQ-Discrepancy model, and 0.75:1 (12 boys, 16 girls) for a Low Achievement model. Because different researchers apply different terminologies and methods of identification, there is a lack of consensus as to whether boys are really more likely to struggle with reading in the early school years.

There is also evidence to suggest that gender ratios vary with age or year of schooling; more boys are identified as poor readers over time. Aaron, Joshi, Gooden, and Bentum (2008) employed a sample of 50 children at-risk for reading failure across Years 2 to 5. Children were included in the study if they were identified by their classroom teachers as being at-risk. Gender ratios for Year 2 students were 0.75:1 (6 boys, 8 girls), indicating that more girls than boys were identified. Gender ratios steadily increased with years of

schooling, however: for Year 3 students the gender ratio increased to 2.5:1 (10 boys, 4 girls), and for Year 5 students the gender ratio further increased to 2.67:1 (8 boys, 3 girls). This (referred) sample was particularly small, however, and even slight changes in the number of students identified could affect reported gender ratios. Galletly et al. (2009) examined student performance on the TOWRE Sight Words and Phonemic Decoding subtests by Year of schooling. Gender ratios for low achievement in Sight Words in Years 2-3 were 1.44:1 (14.1% boys, 9.8% girls) compared to 2.44:1 (24.9% boys, 10.2% girls) for Years 5-6. For Phonemic Decoding, gender ratios were 0.95:1 (9.9% boys, 10.4% girls) for Sight Words in Years 2-3 compared to 1.68:1 (23.4% boys, 13.9% girls) in Years 5-6. On a larger scale, Wheldall and Limbrick (2010) reported gender ratios for poor reading based on performance of a large-scale assessment, the New South Wales Basic Skills Test, across the years 1997 to 2006. Students achieved a single score on a continuous Band for Reading (for Year 3 students, Band 1=lowest and Band 5=highest; for Year 5 students, Band 1=lowest and Band 6=highest). Poor reading was defined as a score in Band 1. They, too, found that gender ratios for poor reading increased with years of schooling, reporting average gender ratios of 1.66:1 (62.3% boys, 37.7% girls) on a sample of 590,532 Year 3 students, and 2.26:1 (69.3% boys, 30.7% girls) for a sample of 543,456 Year 5 students, over a 10-year period. Explanations for this trend are not entirely clear. There is some evidence to suggest that gender ratios increase due to the fact that behaviour gaps increase with years of schooling (Fleming et al., 2004; Prochnow et al., 2001; Smart et al., 2001). It is also possible that gender ratios increase because the variability of boys' scores increases over time, but little research has examined this to date.

Research also suggests that gender ratios for poor reading are affected by the distribution of reading scores for boys and girls (Limbrick et al., 2010). Hawke et al. (2009), for instance, reported that boys demonstrate greater variability in reading scores compared to girls, and this results in more boys scoring in the very tail of the distribution. Consequently, more boys are identified as poor readers. Hawke et al. administered subsets of the Peabody Individual Achievement Test (Reading Recognition, Reading Comprehension, and Spelling) to an overall sample of 1,817 twin pairs aged between 8 years and 20 years, with a mean age of 11.5 years. They reported that boys demonstrated significantly greater variability in scores compared to girls, and concluded that this greater variability resulted in more boys identified.

Similar findings have been reported by performance on the Programme for International Student Assessment (PISA), an assessment for 15-year-old students. Machin and Pekkarinen (2008) reported that girls consistently outperformed boys in reading across all 41 countries. Furthermore, in 35 of the participating countries, boys demonstrated significantly greater variability in scores. Machin and Pekkarinen (2008) concluded that the greater prevalence of boys in the bottom 5% was a result of the greater variability in boys' scores. The studies by Hawke et al. and Machin and Pekkarinen, however, did not examine whether boys' variability was equally evident in specific facets of reading (but rather reading generally) or whether it was evident in the early school years.

A study by Prochnow et al. (2001), however, reached different conclusions. In their longitudinal study on early literacy achievement, they examined the distribution of scores on a range of reading and related measures to ascertain whether more boys were identified

for remediation as a result of the distribution of scores. They found no statistically significant differences between boys and girls.

This article aims to advance existing research on gender and reading by examining the performance of boys and girls on a range of reading and related abilities, calculating gender ratios for poor readers in the early school years across these abilities, and to examine whether boys' variability of scores affects the number of boys in the bottom of the distribution. Poor reading is defined as scoring in the bottom 25% of the distribution, consistent with previous estimates of the percentage of students struggling with reading (Pereira-Laird et al., 1999). This severity of selection is applied across all reading measures to allow for direct comparison of gender ratios. It is of particular interest to determine whether gender ratios vary according to different reading skills and whether gender ratios increase with years of schooling.

Consequently, the aims of this study are:

1. To investigate whether there are statistically significant mean differences between boys and girls on different measures of reading in the early years of schooling.
2. To examine whether boys show greater variability in reading scores than girls.
3. To compare differential gains in reading performance across gender.
4. To ascertain the gender ratios for the bottom 25% of the distribution on the different measures of reading.
5. To ascertain whether gender ratios for poor reading increase with years of schooling.

Method

Participants

The participants in this study were Year 1 and Year 2 students in two regular primary schools in the Western Sydney region of New South Wales. Both schools were considered representative of schools in the State by senior personnel in the local education region, as they were performing at State average levels in State-wide assessments at the time.

There is a diverse student population in both schools, with approximately half the students having language backgrounds other than English (47% in School 1, 50% in School 2). School 1 has approximately 605 students enrolled. The school is located in an area where less than 10% of households have low incomes and 34-48% of households earn more than $2,000 per week (Australian Bureau of Statistics, 2008). School 2 has approximately 595 students enrolled, and is located in an area where approximately 9-16% of households have low incomes and 13-23% of households earn more than $2,000 per week (Australian Bureau of Statistics, 2008).

Students participated in the study if parent consent forms were signed and returned. Of a 339 possible participants, a total of 335 were included in this study. Four students did not participate: two declined, one new student did not have English as a first language, and one student had a significant impairment. The total 335 participating students were from Year 1 and Year 2 across both schools. There were 162 students (81 boys, 81 girls) in Year 1 and 173 students (89 boys, 84 girls) in Year 2 in the first testing session. As some students left the schools after the first testing session, there were 156 students (78 boys, 78 girls) in Year 1 and 165 students (86 boys, 79 girls) in Year 2 in the second testing session. Across both schools there was a range of reading ability, including low-progress readers and readers of higher ability.

Both School Principals agreed to have their schools participate in the project. School and parental permission via consent forms were obtained for all students participating in the study. As both schools were State schools, approval to conduct this project was received by the then New South Wales Department of Education and Training.

Measures

All children participating in this study were administered a range of reading and related assessments (as described below). With the exception of the Wheldall Assessment of Reading Passages (WARP) and Wheldall Assessment of Reading Lists (WARL) (both are currently in development), all assessments are well known and frequently used in existing research. In addition, given the number of participants, as well as the age of participants, assessments were selected which are relatively quick and easy to administer but also demonstrate good reliability and validity.

The purpose of administering a range of assessments was to examine whether there are gender differences in specific facets of reading. To date it remains unclear whether inconsistencies across existing studies in reported gender ratios are resultant of differences in assessments, samples, and severity of selection or whether there are genuine differences between boys and girls. As the participants in this study are in the early school years, and therefore in the acquisition stage of reading, it was decided to measure only lower order reading sub skills, rather than higher order sub skills such as reading comprehension.

Burt Word Reading Test-New Zealand Revision (Burt). (Gilmore, Croft, & Reid, 1981). The Burt Word Reading Test is individually administered and measures single word reading skills. It comprises a list of 110 words of increasing difficulty presented on a stimulus sheet. Students are asked to read the words aloud (untimed). The test is

discontinued after 10 consecutive errors. Raw scores (number of words read correctly) may be converted into a reading age. The Burt Word Reading Test has both high test-retest reliability (>.95) and internal consistency (>.96) (Gilmore et al., 1981).

The Martin and Pratt Nonword Reading Test (Martin & Pratt, 2001). The Martin and Pratt Nonword Reading Test assesses a student's phonological recoding ability. It consists of a list of 54 nonword items which are unfamiliar to students but conform to regular word structures. Students are assessed individually (untimed), and required to read the nonword items aloud. The test is discontinued after eight consecutive errors. The Martin and Pratt Nonword Reading Test has a test-retest reliability co-efficient of .96 (Form A) and .95 (Form B) with high internal consistency reliability coefficient .96. Correlations with the Neale Analysis of Reading Ability demonstrate criterion-related validity of .78-.88 (Martin & Pratt, 2001).

Wheldall Assessment of Reading Lists (WARL) (Reynolds, Wheldall, & Madelaine, 2009b). The WARL is a measure used for identifying young students who would benefit from early intervention. Because it is a curriculum-based measure of reading (CBM), it can be used for regular progress monitoring. It is a measure of word identification fluency and comprises a series of word lists of 150 high frequency sight words taken from popular texts for young students. Each student was required to read aloud three word lists for one minute, and the number of words read correctly was averaged to give a single measure of the words read correctly in one minute. The WARL has high parallel forms reliability (.91-.95). Correlations were high with Burt Word Reading Test (.74-.79), TOWRE Sight Words (.89-.94) and TOWRE Phonemic Decoding (.73-.80). This assessment of word identification

fluency was used because not all low progress readers in the early school years are able to read the passages in the WARP, a measure of oral reading fluency (see below).

Wheldall Assessment of Reading Passage (WARP) (Wheldall & Madelaine, 2000). The WARP is a curriculum-based measure of reading and is used to measure oral reading fluency. It consists of a series of 200 word passages, each passage comprising an entire story. WARP passages have been shown to demonstrate high parallel forms reliability (0.94 to 0.96) and validity (0.78 to 0.80) (Wheldall & Madelaine, 2000). Three WARP passages are typically administered, and the number of words read correctly per minute is averaged over the three passages to yield a single measure of the number of words read correctly in one minute. Not all students in this study were administered the WARP. Only students who averaged 30 words per minute on the WARL were administered the WARP (n=241). These students were required to read 3 passages, each for 1 minute, at pre- and post-test.

Peabody Picture Vocabulary Test-Fourth Edition (PPVT-IV) (Dunn & Dunn, 2007). The PPVT-IV assesses single word receptive vocabulary. Students are individually assessed and presented with a form containing four pictures. There are 228 forms (test items) in total, divided into 19 sets (12 forms per set). Students are given a stimulus word and are asked to identify which picture from the array of four depicts that stimulus word. The test is discontinued when 8 or more errors are recorded in a set. The PPVT-IV has high internal consistency reliability (>.94) and high test-retest reliability (.93). High correlations have been reported with the Expressive Vocabulary Test, ranging .80-.84 (Williams, 2007) and the Clinical Evaluation of Language Fundamentals (CELF, Semel, Wiig, & Secord, 2003).

Sutherland Phonological Awareness Test-Revised (SPAT-R) (Neilson, 2003b). The SPAT-R assesses phonological knowledge commonly acquired in the early years of schooling. Phonological awareness skills are essential for successful reading. Tasks involve blending, sound identification, segmenting, phoneme deletion, spelling, and non-word reading. The SPAT-R contains 13 subtests. Subtests 1-11 are auditory and require no reading or writing responses. These subtests are discontinued if the student responds incorrectly for the first two test items. Subtests 12-13 examine nonword reading and spelling, with discontinuation if the student incorrectly responds to the first two items. The SPAT-R has high internal consistency (.95) and is highly correlated with both the Woodcock Reading Mastery Test (Woodcock, 1987) (.78) and Astronaut Invented Spelling Test (Neilson, 2003a) (.86).

South Australian Spelling Test (SAST) (Westwood, 1999). The SAST is a standardised spelling achievement assessment using real words that increase in difficulty. Each word is presented by itself and then used in a sentence (provided to the assessor). The student is required to write out each spoken word on a form. The test is untimed and discontinued after 10 consecutive errors. The test can be administered individually or to a group of students, although in this study the test was administered individually. Raw scores (total items correct) are converted to an approximate spelling age. The SAST has a test-retest reliability of .96.

Research Procedures

Following recruitment of suitable participants, and the relevant consent forms being obtained from parents and school principals, students in Years 1 and 2 were assessed at two different points: at the beginning of the school year (late February/early March, 2009), and

in the middle of the school year (late July/early August, 2009). Students were assessed on the Burt, Martin and Pratt, WARL, WARP, PPVT SPAT-R, and SAST. At each point testing took approximately four weeks. Students from both schools were tested at the same time. Time taken for assessing each student was approximately 60 minutes. This was split into three sessions of 20 minutes each and was carried out on different days to prevent student fatigue.

Testing was conduced by trained research assistants. Each student was tested individually either in a quiet room or at a testing station in a designated classroom. Random double-scoring was carried out by the research assistants to ensure consistency of marking.

Analysis

Given that the analyses of these data involve multiple family wise comparisons, it was decided to employ a more stringent alpha level ($p<0.01$) in lieu of a Bonferroni correction. (In the event, this proved to be largely academic since so few comparisons even approached statistical significance.) Analyses of covariance were employed to assess gender differences in gains made over the two terms between testings.

Results

Gender Differences in Mean Scores

Table 1 (see Appendix 1) summarises the means and standard deviations for Years 1 and 2 students on all reading measures. Results are presented by gender across two testing points (February and August). Small differences between boys and girls overall were evident (in both directions), but none of these differences were statistically significant (at the specified alpha level of $p<0.01$) at either testing point for Year 1 or Year 2 students.

Effect sizes were also calculated (see Table 1). Effect size is a determination of the power or strength of the relationship between two variables, and is typically considered small (0.2-0.5), medium (0.5-0.8) or large (0.8 or greater) (Cohen, 1992). Effect size (d) is calculated by: (Mean 1 – Mean 2)/combined standard deviation. In Year 1, effect sizes ranged from -.06 to -.36. Year 2 effect sizes ranged from .02 to .30. These effect sizes are small, indicating that any mean differences between boys and girls are negligible.

Gender Differences in the Variability of Scores

Table 2 presents the results of statistical significance testing of differences in variability of scores for boys and girls overall (Levene's Test for Equality of Variances). There were no statistically significant differences (at the specified alpha level of $p<0.01$) between boys and girls observed for any measure at any testing point for either year except: Year 1 on the Burt (February) ($F=7.808$, $p<0.01$); and Year 1 on the SAST (August) ($F=9.649$, $p<0.01$), where boys demonstrated significantly greater variability. This provides only limited evidence for the greater variability of boys' scores compared to girls'.

Table 2

Significance of Tests of Gender Differences in Variability of Scores for Reading and Reading-Related Measures, by Year and Testing Point

		May		August	
		F	P	F	P
Year 1	Burt	7.808	.006*	3.456	.065
	M&P	6.144	.014	5.360	.022
	WARL	5.168	.024	3.530	.062
	WARP	.581	.448	1.838	.178
	PPVT	.061	.805	1.333	.250
	SPAT	.971	.326	.610	.436
	SAST	4.826	.029	9.649	.002*
Year 2	Burt	2.031	.156	5.259	.023
	M&P	.080	.777	.238	.626

WARL	.748	.388	.000	.985
WARP	.803	.372	.126	.723
PPVT	.211	.647	1.093	.297
SPAT	.084	.772	.041	.839
SAST	2.264	.134	2.853	.093

* denotes significance at the .01 level

Gains by Gender

All reading assessments were administered twice (February and August). Analyses of covariance of scores in August were used to examine gains in performance by gender (covarying February scores). Analysis of gains by individual Years (Grades) revealed almost no gender differences. In Year 1 there were no statistically significant differences between boys and girls in gains made on the Burt (F=2.803, p=.096), Martin & Pratt (F=6.229, p=.014), WARL (F=1.995, p=.160), WARP (F=.086, p=.770), PPVT (F=3.173, p=.077), and SPAT (F=4.100, p=.045). Effect sizes (Partial Eta Squared) for these measures ranged from .001 to .039.

In Year 2 the only statistically significant difference between boys and girls was for gains made on the PPVT (F=9.400, p<.01), however, a very small effect size (.055) was also found. Gender differences were not significant on the Burt (F=5.445, p=.021), Martin & Pratt (F=.093, p=.761), WARL (F=.059, p=.808), WARP (F=2.650, p=.106), and SPAT (F=.502, p=.480). Effect sizes (Partial Eta Squared) for these measures ranged from .000 to .055.

Given the extremely small effect sizes for gender differences in gains made, it appears that boys and girls made the same progress on these measures in both Years 1 and 2.

Gender Ratios for Poor Readers

Gender ratios (boy : girl) for poor readers, defined as the bottom 25% of the distribution of scores for each test, are presented in Table 3. Gender ratios for poor readers were calculated for each reading measure, by Year, at each testing point.

Gender ratios for low-progress Year 1 students ranged from 0.82:1 to 1.22:1. There were equivalent numbers of boys and girls (1:1) on the Burt (February), Martin & Pratt (February), and SAST (February). On the Martin & Pratt (August), PPVT (August), SPAT-R (February, August), and WARL (August), there were more girls than boys identified as poor readers.

Table 3

Gender ratios for bottom 25% by Year and Testing Point

	Year 1		Year 2	
	May N=162	August N=156	May N=173	August N=165
Burt	1:1	1.05:1	1.26:1	1.41:1
M&P	1:1	0.86:1	1.15:1	1.05:1
WARL	1.22:1	0.95:1	1.39:1	1.41:1
WARP	n/a	n/a	1.86:1	2.55:1
PPVT	1.22:1	0.95:1	1.53:1	2.15:1
SPAT	0.82:1	0.86:1	1.39:1	1.28:1
SAST	1:1	1.05:1	1.53:1	1.73:1

Gender ratios for Year 2 poor readers were consistently higher than for Year 1 across all measures. Gender ratios ranged from 1.05:1 to 2.55:1 (see Table 2). In Year 2, there were consistently more boys than girls in the bottom 25% of the distribution on all measures. Gender ratios thus increased with years of schooling.

Across all six measures, poor reading was defined as a score in the bottom 25% of the distribution. Very few children scored in the bottom 25% across *all* measures. In Year 1, only 30% of students were identified as poor readers on all six measures in February, and 23% in August. For Year 2, 16% of students overlapped across all six measures in February, and 14% overlapped in August. Different students were identified in the bottom 25% depending on the skills measured.

Discussion

Previous studies on reading ability in the early school years have varied considerably in terms of assessments employed and reading skills measured. While some have focused on gender differences in phonological awareness (Moura et al., 2008; Puolakanato et al., 2007), for example, others have measured gender differences in decoding or reading comprehension (Lepola, 2004; Prior et al., 1995). Few studies have examined whether there are gender differences across a range of specific reading and related skills using a single sample (Prochnow et al., 2001). In this study, we advance existing research by examining whether boys and girls vary in different skills required for reading and report gender ratios for each skill. Six literacy measures were administered to a population sample of Years 1 and 2 students, and no statistically significant mean differences were found on any of the reading skills including word and non-word reading skills, phonological recoding ability, phonological awareness, reading fluency, single word verbal ability, and spelling. There was no aspect of reading in which boys demonstrated a particular weakness. These results support previous studies that also demonstrate that in the early school years, boys and girls have very similar reading and related abilities (Entwistle et al., 2007; McCoach et al., 2006; Prochnow et al., 2001; Savage & Carless, 2004). Furthermore, in

this study rates of progress for boys and girls were almost identical with the exception of gains made on the PPVT in Year 2. The effect sizes for these differences in gains, moreover, were quite small, indicating negligible gender differences. These findings are consistent with existing research which indicates few, if any, differential gains between boys and girls (Below et al., 2010; Chard et al., 2008; Wang et al., 2008).

Gender Ratios for Poor Reading

Previous studies have reported gender ratios for poor reading generally (Chan et al., 2007; Hawke, Wadsworth, Olson, & DeFries, 2007; Miles, Haslum, & Wheeler, 1998); in this study we report gender ratios for poor performance across a range of reading and related skills for a single sample for Year 1 and Year 2 students at two points in the school year. Gender ratios ranged from 0.82:1 to 1.22:1 for Year 1 students and 1.05:1 to 2.55:1 for Year 2 students. In Year 1 there were not consistently more boys than girls in the bottom 25% of the distribution; in some instances, there were more girls than boys. On the Burt, Martin & Pratt, and SAST, there were equivalent numbers of boys and girls identified in the bottom 25%. In Year 2, however, there were consistently more boys than girls in the bottom 25%, but the degree to which there were more boys was not large in the majority of instances. Consistent with previous research, there may be more boys than girls who are poor readers, but the degree to which there are more boys is not substantial (Limbrick, Wheldall, & Madelaine, 2010; Siegel & Smythe, 2005; Wheldall & Limbrick, 2010), nor is this the case in all aspects of reading. In Year 1, boys significantly outperformed girls in phonological recoding ability.

Gender ratios for poor reading were slightly larger in Year 2 than in Year 1, consistent with previous research indicating that gender ratios for poor reading increase with years of

schooling (Aaron et al., 2002; Skårbrevik, 2002). The reason for this trend is not entirely clear. There is some evidence to suggest that gender ratios for poor reading are affected by the variability in boys' scores. Hawke et al. (2009) and Machin and Pekkarinen (2008) found that boys' greater variability in scores can result in more boys scoring in the bottom of the distribution. As a result, more boys are identified as poor readers. Whether this variability in boys' scores fluctuates across school years has yet to be determined. In this study, we found very limited evidence to support greater variability in boys' scores (Burt and SAST in Year 1 only), and this variability did not result in more boys scoring in the bottom of the distribution: gender ratios on the Burt and SAST were 1:1 and 1.05:1 respectively. These findings are consistent with the findings reported in Prochnow et al. (2001). It is possible, however, that variability in boys' reading scores may not be as evident in the early school years compared to later school years as previously reported (Hawke et al., 2009; Machin & Pekkarinen, 2008). Moreover, if boys' variability increases with years of schooling or age, then this could account for increasing gender ratios over time.

Another potential explanation for increasing gender ratios across school years is that gender ratios may be iatrogenic in nature (i.e. gender differences are *created* by schooling). If boys and girls commence school with very similar reading ability, but gender gaps in reading ability increase with years of schooling, it is possible that other factors may contribute to more boys struggling with reading over time. For example, there is evidence to suggest that boys' behaviour (in some instances at least) is not always a good 'fit' with school expectations (Entwistle et al., 2007; Gorard, Rees, & Salisbury, 2001; Skårbrevik, 2002). Significant gender differences have been reported in behaviour, even in the early

school years (Lepola, 2004; Matthews et al., Onatsu-Arvilommi & Nurmi, 2000; 2009; Prochnow et al., 2001; Prior et al., 1995), and this behaviour gap increases with years of schooling (Fleming et al., 2004; Smart, Prior, Sanson, & Oberklaid, 2001). Given the established link between poor reading and troublesome behaviour (Rowe & Rowe, 1999; Smart et al., 2001), there may be no real differences between boys and girls in reading initially, but significant differences in *behaviour* between boys and girls, and teacher responses to behaviour (Beaman, Wheldall, & Kemp, 2006), could result in different academic outcomes over time (Entwistle et al., 2009; Gorard et al., 2001). As this study did not measure behaviour, it is difficult to determine to what degree behaviour affected increasing gender gaps. Future research could examine this issue in more detail.

Although gender ratios increased slightly with years of schooling, the finding that there were almost as many girls as boys identified as poor readers suggests that, contrary to common belief, poor reading is not largely a male phenomenon. It is possible that the assumption that poor reading is more prevalent among boys is not due to actual gender differences in reading, but rather factors such as the overuse of referred samples. Others have reached similar conclusions (Prochnow et al., 2001; Shaywitz, Shaywitz, Fletcher, & Escobar 1990; Smart et al., 2001). Furthermore, as indicated by Hyde (2005), when examining the magnitude of effect sizes, boys and girls are more alike than not on measures of reading. Hyde conducted a large meta-analysis and concluded that gender differences were over-inflated and inconsistent with empirical data. If gender is not a strong or consistent indicator of reading, then more attention should be given to factors known to affect reading outcomes, such as phonological awareness (Singleton et al., 1999) or socio-economic status (Fluss et al., 2009; Strand et al., 2006), rather than gender.

Limitations of the Study

The present study did not measure student behaviour and hence the degree to which behaviour might contribute to increasing gender gaps in reading. Future studies might consider measuring not only behaviour, but also comparing teacher judgements about boys' and girls' performance to actual performance on standardised tests.

Conclusion and Future Research

The findings in this study indicate that there are few, if any, gender differences in different areas of reading and related skills in the early school years. Boys and girls, for the most part, did not differ in mean scores or rates of progress. The findings in this study advance existing research by reporting gender ratios for poor reading over a range of skills critical for reading success. While relatively low, gender ratios for Year 2 students were consistently higher than those for Year 1. Although boys and girls commence school with very similar abilities, gender ratios for poor performance appear to increase with years of schooling.

In the early school years, it does not appear that boys demonstrate greater variability in a range of reading and related skills. There were only two instances where boys' scores showed significantly greater variability but the effect sizes were very small, and this variability did not result in greater gender ratios for poor performance. It is possible that variability in boys' scored increases with years of schooling, which would account for increasing gender ratios over time. According to previous research, however, another possible explanation for increasing gender ratios relates to gender differences in behaviour which was not assessed in his study.

Given that fewer than 30% of poor readers were identified as such on all six measures, and that gender ratios remained relatively stable despite this small percentage, it does not appear that gender is a strong or consistent predictor of reading ability. Others have reached similar conclusions (Fluss et al., 2009; Limbrick et al., 2011; Limbrick et al., 2010; Strand, Deary, & Smith, 2006). While different students have different strengths and weaknesses in reading, these strengths or weaknesses are not as closely linked with gender as previously thought (Liederman et al., 2005); there are almost as many girls who are poor readers. These findings therefore highlight the importance of identifying *all* students who are poor readers, irrespective of gender.

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Table 1

Means, Standard Deviations, Statistical Significance and Effect Sizes across two testing points, by grade and gender

	February					August				
	Boys N=81	Girls N=81	t	p	*d*	Boys N=78	Girls N=78	t	p	*d*
YEAR 1 BURT	27.51 (15.50)	24.7 (11.21)	1.319	0.189	-0.21	39.46 (17.91)	34.95 (13.53)	1.776	0.078	-0.29
M&P	102.46 (18.13)	99.59 (13.36)	1.085	0.28	-0.17	108.79 (18.77)	102.44 (16.20)	2.264	0.025	-0.36
WARL	36.83 (23.92)	32.44 (19.56)	1.276	0.204	-0.2	57.91 (26.26)	51.42 (21.01)	1.704	0.09	-0.27
PPVT	96.70 (20.41)	97.21 (20.17)	-0.159	0.874	0.12	109.13 (20.47)	106.59 (17.54)	0.832	0.407	-0.13
SPAT	31.31 (13.00)	30.62 (11.7)	0.356	0.723	-0.06	38.1 (11.94)	35.64 (10.96)	1.341	0.182	0.21
SAST	17.48 (10.03)	16.84 (8.06)	0.449	0.654	-0.07	23.69 (9.81)	22.46 (7.36)	0.886	0.377	-0.14
YEAR 2 BURT	41.01 (16.75)	42.07 (13.69)	-0.454	0.65	0.07	49.66 (18.94)	48.62 (14.97)	0.39	0.697	-0.06
M&P	102.91 (17.29)	103.18 (15.78)	-0.106	0.915	0.02	104.29 (18.61)	103.81 (17.26)	0.172	0.864	-0.03

WARL	59.75 (22.36)	61.12 (21.19)	-0.412	0.681	0.06	70.72 (22.25)	72.38 (22.32)	-0.478	0.633	0.07
WARP	63.15 (32.45)	69.08 (31.37)	-1.171	0.244	0.19	81.09 (34.88)	90.77 (34.38)	-1.752	0.082	0.28
PPVT	110.97 (18.62)	112.65 (18.64)	-0.596	0.552	0.13	117.66 (19.32)	123.46 (16.96)	-2.04	0.043	0.25
SPAT	38.84 (9.94)	40.51 (10.45)	-1.077	0.283	-0.16	41.50 (9.38)	43.27 (9.38)	-1.208	0.229	-0.19
SAST	25.17 (8.74)	27.45 (7.44)	-1.845	0.067	0.28	28.34 (8.97)	30.78 (7.54)	-1.88	0.062	0.3

CHAPTER 8: DO BOYS NEED DIFFERENT REMEDIAL READING INSTRUCTION FROM GIRLS?

Chapter Overview

This Chapter includes an empirical study accepted for publication in the *Australian Journal of Learning Difficulties* (Limbrick, Wheldall, & Madelaine, in press).

The findings reported in previous Chapters confirm that only very small differences between boys and girls are evident in various facets of reading and, although gender ratios can vary depending on the skill measured and year of schooling, these ratios are relatively low. These findings are important because they highlight that when using population samples and methods of low achievement which isolate the tail end of the distribution, there is not a preponderance of boys identified as poor readers. This appears to be evident in measures of reading comprehension (Chapters 4 and 5), oral reading fluency (Chapter 6), and across a range of reading and related abilities in the early school years (Chapter 7). These findings add weight to the belief that boys are more likely to be identified as poor readers may be owing to methodological factors rather than actual differences between boys and girls in reading.

The previous Chapters have reported benchmark gender ratios for poor reading, and examined whether there are gender differences in various facets of reading. Not addressed in these Chapters, however, is the issue of whether boys and girls who have already been identified as poor readers make similar progress in various facets of reading with appropriate intervention. Although a number of programs have been specifically designed to improve boys' reading (Atkinson, 2009; Dahlhauser, 2003; Farris, Werderich, Nelson, & Fuhler, 2009), several researchers have indicated that boys and girls struggling with reading

may make similar progress with the same intervention (Linklater, O'Connor, & Palardy, 2009; Savage & Carless, 2004).

The following study was conducted to ascertain whether boys and girls identified as poor readers make similar progress with appropriate intervention, particularly intervention which addresses the critical aspects of reading. The MultiLit Program, an empirically-based, non-categorical reading program with demonstrated efficacy, is one such intervention. The MultiLit Program was administered to a sample of 398 students in Year 5 and 6 who had already been identified as poor readers. Participants were assessed pre- and post-intervention on six reading and related measures. It was found that boys and girls made almost identical progress in reading after participating in the MultiLit Program, and the progress made by both boys and girls was substantial. Effect sizes for gender differences were very small. As evidenced by pre- and post-tests, boys did not struggle with any particular facet of reading. It was concluded that boys do not require different forms of remedial reading instruction to girls. This study contributes to existing literature by uniquely demonstrating that MultiLit is effective for both boys and girls who are poor readers.

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Do Boys Need Different Remedial Reading Instruction From Girls?

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Abstract

Recent inquiries into the underachievement of boys in reading have called into question whether they require different forms of reading instruction from girls. A number of reading programs and initiatives have been developed to address this issue, including programs based on increasing boys' motivation, improving behaviour, embracing the use of computers, and so forth. The aim of the present study was to test the hypothesis that effective remedial reading instruction is equally effective for boys as well as girls. The sample comprised 398 low progress students (239 boys, 159 girls) in Years 5 and 6 who attended an off-site tutorial centre for two school terms between the years 2005 and 2010. All boys and girls in the sample participated in the Schoolwise Program, a non-categorical empirically-based reading program, for three hours daily. Participants were assessed pre- and post- intervention on five reading and related measures. Both boys and girls made substantial gains, analyses of covariance confirming that their rates of progress were very similar. Small effect sizes were also reported. It is concluded that boys and girls do not require different forms of reading instruction if both are provided with effective systematic remedial reading instruction.

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Do Boys Need Different Remedial Reading Instruction From Girls?

In recent decades it has been claimed that up to 38% of students have a reading disability (Aaron, Joshi, Gooden, & Bentum, 2008), and a considerable proportion of these students are boys (Flannery, Liederman, Daly, & Schultz, 2000; Liederman, Kantrowitz, & Flannery, 2005; Miles, Haslum, & Wheeler, 1998; Rutter et al., 2004). Indeed, it has previously been reported that boys are up to five times more likely to be identified as having a reading disability than girls (Jorm, Share, Matthews, & MacLean, 1986). Such findings have prompted calls for closer attention to the education of boys.

In 2002 the Australian Government's Department of Education, Employment and Workplace Relations requested an inquiry into the education of boys in Australian schools, which was conducted by the House of Representatives Standing Committee on Education and Training. In their final report (House of Representatives, 2002), it was found that boys were not achieving as well as girls across a wide range of educational domains, including literacy. The report also found that Year 3 and 5 girls were achieving five percentage points higher than boys. In more recent years, similar results have been found for the National Assessment Program - Literacy and Numeracy (NAPLAN), a nationwide large-scale assessment covering reading, writing, punctuation and grammar, spelling and numeracy, which was introduced in 2008. Since the inception of NAPLAN, a greater percentage of boys compared to girls have failed to reach the minimum national reading standards in Years 3, 5, 7 and 9.

This pattern of under-attainment by boys is not only evident in Australia but also in other OECD (Organisation for Economic Co-operation and Development) countries, including the UK, the United States and Canada. On the Programme for International

Student Assessment (PISA), a large-scale assessment administered to 15-year-old students internationally, for instance, girls consistently scored higher in reading than boys across all 41 countries in the years 2000, 2003 and 2006 (Lynn & Mikk, 2009; Machin & Pekkarinen, 2008), with more boys in the bottom 5% of the distribution. Similarly, in the US National Assessment of Education Progress (NAEP) results, girls outperformed boys in reading, with a 15% gender gap reported (Baer, Baldi, Ayotte, & Green, 2007; Salahu-Din, Persky, & Miller, 2008). In recent times a report by the US Center on Education Policy (CEP, 2010) revealed that girls outperformed boys in reading at elementary, middle and high school levels. It was also found that more girls reached basic levels of reading than boys. Researchers in the field of education have also reported gender differences in reading performance in favour of girls (Badian, 1999; Beringer, Nielsen, Abbott, Wijsman, & Raskind, 2008; Chan, Ho, Tsang, Lee, & Chung, 2007; Coutinho & Oswald, 2005; Flannery et al., 2000; Hoskyn & Swanson, 2000; Liederman et al., 2005; Miles et al., 1998; Rutter et al., 2004; Yoshimasu et al., 2010).

Such findings raise the question of whether boys and girls require different forms of reading instruction. In recent years many different types of programs and initiatives have been designed to improve boys' reading and thus close the reported gender gap in reading. For example, some have advocated that reading programs should address ways of increasing boys' levels of motivation (Atkinson, 2009; Dahlhauser, 2003; Gaynor & Stephen, 2006), or identify boys' reading preferences so that they can have access to books that they are interested in (Farris, Werderich, Nelson, & Fuhler, 2009; Hall & Coles, 1997; Moss, 2000). Other programs have been based on improving boys' behaviour as a way of improving reading skills (Dos Santos Ellas, Marturano, de Almeida Motta, & Giurlani, 2003). Some

researchers have suggested that boys require different forms of reading instruction because they demonstrate different learning styles (Logan & Johnston, 2009). Reading programs have also been grounded on the belief that boys make better progress with male teachers (Butler & Christianson, 2003; Carrington & Skelton, 2003; Sokal, Katz, Chaszewski, & Wojcik, 2007; Sokal et al., 2005; Sokal & Katz, 2008), or with the use of computers and technology (Leino & Malin, 2006; Littleton, Wood, & Chera, 2006; Sokal & Katz, 2008). Programs have also been designed to improve boys' reading through sport (Palmer, 2008), boys-only book clubs (Brozo, 2007; Weih, 2008), and cognitive-based strategies (Ghobari Bonab & Raghebian, 2009).

There are several concerns, however, regarding the efficacy of these programs. Throughout the literature, a considerable number of programs specifically designed for boys are not empirically-based, have small or referred samples, or do not address the critical skills needed for reading. Other programs recommend interventions for boys that would benefit all students, irrespective of gender.

Furthermore, the common thread among programs specifically for boys is that they are often founded on particular explanations for why there are reported gender gaps in reading. In other words, they are governed by emphasis on the possible causes for achievement gaps between boys and girls. There is evidence to suggest, however, that this approach to reading may not be the most effective. A recent review by Limbrick, Wheldall, and Madelaine (2011) examined the empirical evidence supporting the most common explanations proposed for reported differences between boys and girls, including differences in phonological awareness, auditory processing, behaviour, neurology, cognitive variance and motivation. They found that many studies across these explanations reported small effect

sizes or only very small differences between boys and girls in reading. Limbrick et al. concluded that although these explanations play, in part, a role in successful reading generally, none could adequately explain reported gender differences in reading outcomes.

In a similar vein, the Australian Government National Inquiry into the Teaching of Reading (NITL) concluded that too much emphasis is placed on the possible reasons for difficulties in reading, and not enough emphasis is placed on *what* and *how* a teacher should teach (DEST, 2005). Rather, what is more important is quality teaching in the critical aspects of reading, irrespective of a student's background (DEST, 2005). DEST (2005) further reported:

> "Findings from the research evidence indicate that all students learn best when teachers adopt an integrated approach to reading that explicitly teaches phonemic awareness, phonics, fluency, vocabulary knowledge and comprehension" (p.11)

Similar findings have been reported in the United States. The National Reading Panel (2000) reported that children require solid instruction in critical areas of reading including phonemic awareness, phonics, fluency, independent silent reading, comprehension, vocabulary, and text comprehension. An independent report in the UK (Rose, 2009) concurs with these recommendations. Based on these findings, it may be that boys do not require different forms of reading instruction to girls, but rather, like girls, would benefit from empirically-based instruction based on the critical aspects of reading. Furthermore, although a large body of research advocates that there are considerably more boys than girls who are poor readers, evidence based on empirical research using population or random samples

suggests that the degree to which there are more boys than girls is not as large as previously thought (Limbrick, Wheldall, & Madelaine, 2011; Siegel & Smythe, 2005; Share & Silva, 2003; Wheldall & Limbrick, 2010). As such, it is also possible that low-progress boys do not require different forms of remediation (based on the possible causes for poor reading), but that effective remedial reading instruction would be equally effective for boys as for girls.

One such approach to helping low-progress readers is known as MultiLit ('Making Up Lost Time In Literacy') (Wheldall & Beaman, 2000). MultiLit is predicated on a non-categorical approach to reading instruction; in other words, it does not focus on the possible reasons or underlying causes for low-progress reading but instead advocates that all children can learn with effective instruction (Wheldall, 1994; Wheldall & Beaman, 2000; Wheldall & Carter, 1996). MultiLit is an intensive, systematic reading program, encompassing the critical aspects of effective reading (phonemic awareness, phonics, fluency, vocabulary, and comprehension). Furthermore, MultiLit is an empirically-based reading program which has been highly replicated (see, for example, Pogorzelski & Wheldall, 2002; Wheldall, 2009; Wheldall & Beaman, 2000, 2011). Previous studies have demonstrated that low-progress disadvantaged readers have made significant gains using MultiLit (Wheldall, 2009; Wheldall & Beaman, 2000), including particular groups of students such as those at risk (Wheldall & Beaman, 2011), students with disabilities or special needs (Wheldall & Limbrick, 2005) and Indigenous students (Wheldall & Beaman, 2011; Wheldall, Beaman, & Langstaff, 2010).

The aim of this study was to compare the reading gains made by boys and girls, who were all low-progress readers, following MultiLit instruction. Establishing whether boys and

girls make similar progress when using an empirically-based intensive reading program has implications not only for the future direction of research in reading, but would also offer a practical contribution to the way forward in addressing boys' reading outcomes.

Method

Participants

The participants in this study comprised 12 cohorts of Years 5 and 6 students who attended a charitably funded tutorial centre based in Ashfield, New South Wales, between the years 2005 and 2010. Participants attended the centre three hours every morning for two school terms (see Intervention below). In each cohort there were approximately 36 students across Years 5 and 6. Participants were placed in small groups of six based on ability, and each group contained a mix of boys and girls. A small number of children left the program part way through, but pre- and post-test data were available for 398 students (239 boys, 159 girls) across the six years. Students were referred to the tutorial centre by local schools if they were classified as low-progress readers, defined as scoring in the bottom 25% for reading accuracy on the Neale Analysis of Reading Ability (3rd ed., Neale, 1999). (The Neale was administered by school staff.)

At pre-test the mean *chronological* age was 11 years for boys and 10 years 11 months for girls; the mean *reading* age on the Neale reading accuracy and reading comprehension subtests were 7 years 6 months and 7 years 3 months respectively for boys, and 7 years 8 months and 7 years 3 months respectively for girls. Therefore, both boys and girls may be said to have been more than three years behind their typically developing peers in both reading accuracy and comprehension.

Measures

Students were assessed on a battery of reading and related measures at the commencement of the program (pre-test) and again after approximately 18 weeks of instruction (post-test). The test battery consisted of the following tests:

The Neale Analysis of Reading Ability (3rd ed., Neale, 1999). The Neale Analysis of Reading Ability is a standardised reading test which measures both reading accuracy and reading comprehension. It is administered individually. Students are asked to read aloud set passages and answer open-ended questions for each passage. In total there are six passages of increasing difficulty. Accuracy is determined by the number of errors recorded. Comprehension is determined by the number of correctly answered questions. Raw scores may be converted into standard scores, percentile ranks and reading ages. The Neale has high internal consistency for both accuracy and comprehension (0.71 to 0.96) (Neale, 1999).

Burt Word Reading Test-New Zealand Revision (Burt). (Gilmore, Croft, & Reid, 1981). The Burt Word Reading Test measures word reading skills. It is individually administered and contains a list of 110 words of increasing difficulty. Words are presented on a stimulus sheet and students are asked to read the words aloud (untimed). After 10 consecutive errors the test is discontinued. Raw scores (number of words read correctly) may be converted into a reading age (Years : Months). The Burt Word Reading Test has both high internal consistency (>.96) and test-retest reliability (>.95) (Gilmore et al., 1981).

Wheldall Assessment of Reading Passages (WARP) (Wheldall, 1996). The WARP is a curriculum-based measure of oral reading fluency, consisting of a series of 200 word passages. Each passage comprises an entire story (narrative) and all passages are highly correlated with each other (Madelaine & Wheldall, 1998; Wheldall & Madelaine, 2000). Passages are set at the same level of difficulty. A WARP score denotes the number of words

read correctly per minute averaged over three passages. WARP passages have high parallel forms reliability (.94 to 0.96) and criterion validity (.78 to .80) with reading accuracy (see Wheldall & Madelaine, 2000).

South Australian Spelling Test (SAST) (Westwood, 2005). The SAST is a standardised spelling achievement test of real words that increase in difficulty. Each word is orally presented and then used in a sentence. The student is required to write out each spoken word. The test is untimed and discontinued after 10 consecutive errors. The SAST can be administered individually or to a group. Raw scores (total items correct) are converted to an approximate spelling age. The SAST has a test-retest reliability of .96 (Westwood, 2005).

The Martin and Pratt Nonword Reading Test (Martin & Pratt, 2001). The Martin and Pratt Nonword Reading Test assesses phonological recoding ability. It consists of a list of 54 psuedowords of increasing difficulty. Students are assessed individually (untimed), and required to read the psuedowords aloud. The test is discontinued after eight consecutive errors (mispronunciations). The Martin and Pratt Nonword Reading Test has a test-retest reliability co-efficient of .96 (Form A) and .95 (Form B) with high internal consistency reliability coefficient .96. It demonstrates high criterion-related validity with the Neale Analysis of Reading Ability (.78-.88) (Martin & Pratt, 2001).

Intervention

The Schoolwise MultiLit Program at the Exodus Tutorial Centre is an intensive evidence-based remedial reading program for older low-progress readers (in the final years of primary school or first year of high school) identified as ‘at risk’ based on social disadvantage, low levels of literacy and risk of disaffection from school. The program is

designed for use in the centre, and covers all five major facets of effective reading instruction (phonemic awareness, phonics, fluency, vocabulary and comprehension). Its main focus is a group version of the MultiLit Reading Tutor Program (MultiLit, 2007) which comprises MultiLit Word Attack Skills, MultiLit Sight Words and MultiLit Reinforced Reading (see below), as well as other evidence-based programs such as the SRA Spelling Mastery program (Dixon, Engelmann, & Bauer, 1999).

Each cohort of students attended the centre for two school terms (approximately 18 weeks), Monday to Friday from 8.30am to 11.30am. Each daily session consisted of group MultiLit Word Attack Skills, MultiLit Sight Words, MultiLit Reinforced Reading, group spelling and 'home group' (individual sessions, independent work, and peer tutoring). Boys and girls were taught together within the centre, rather than in separate groups. Students participated in the program in small groups averaging six students per group. Students were placed in groups determined by ability, and these groups varied depending on the program component and progress made.

MultiLit Word Attack Skills (MultiLit, 2007a). MultiLit Word Attack Skills was developed for teaching older low-progress readers phonic word attack skills, which are essential for rapid decoding and competent reading. The three components of MultiLit Word Attack Skills are accuracy, fluency and spelling. At commencement each student is given a placement test to assess letter-sound knowledge, decoding and blending skills. Each level of the program is progressively more difficult, with necessary pre-skills taught first. A student has completed a level when both the reading accuracy and fluency mastery criteria are satisfied (Wheldall & Beaman, 2000).

MultiLit Sight Words (MultiLit, 2007b). MultiLit Sight Words teaches the automatic recognition of the most frequently used words. It includes 200 words divided into 20 groups (10 cards of words at each level). Students are assessed on their ability to read the lists of sight words, and progress to the next list if all words are read correctly. Students need to achieve 100% before moving to the next list. The three teaching components are: current list of words, revision, and cumulative review. This assists in learning new words, achieving automaticity, and establishing words in long-term memory (Wheldall & Beaman, 2000). There is also a spelling component.

MultiLit Reinforced Reading using Pause, Prompt, and Praise (MultiLit, 2007c). MultiLit Reinforced reading was designed to improve students' independent reading skills. It is based on the Pause, Prompt and Praise tutoring strategy developed for use with older low-progress readers. Research shows that the techniques used in MultiLit Reinforced Reading are highly successful for improving the reading ability of low-progress readers (see Wheldall & Beaman, 2000). Students are taught by trained tutors who provide positive reinforcement for good reading through highly specific praise (Wheldall & Beaman, 2000).

Design and Analysis

Students attending the Exodus Tutorial Centre were assessed twice (commencement and completion) on the abovementioned battery of reading and related measures (Neale, Burt, WARP, SAST, Martin & Pratt). All assessments were conducted by trained research assistants.

All results were analysed by gender. Pre- and post-test raw scores were analysed using t-tests. Overall gains were analysed using analyses of covariance. Given that the analyses of

these data involve multiple family wise comparisons, we employed a more stringent alpha level ($p<0.01$) in lieu of a Bonferroni correction.

Results

Table 1 (see Appendix 1) presents means and standard deviations for boys ($N = 239$) and girls ($N=159$) separately at pre- and post-test on the Neale, Burt, WARP, SAST, and Martin & Pratt. The results of t-tests are also shown. Although boys presented with slightly lower scores on all measures at pre-test (program commencement), statistically significant differences in means were only found for the WARP ($t=2.701$, $p<.01$) and the SAST ($t=4.034$, $p<.01$). No other differences in mean scores at pre-test were statistically significant ($p>.01$). At post-test (program completion), there were no statistically significant differences in means between boys and girls with the exception of SAST ($t=4.002$, $p<.01$). There were no statistically significant gender differences in the variability of scores at either pre-test or post-test ($p>.01$).

Effect sizes were also calculated (see Table 1). Effect size (Cohen's *d*) establishes the power or strength of the relationship between two variables, and can be considered small (up to 0.3), medium (approximately 0.5) or large (more than 0.8). An effect size of 1.0 indicates an increase of 1 Standard Deviation, which is the expected growth rate during one school year (Hattie, 1992). Effect sizes for differences between boys and girls were small, ranging from .01 to .41, indicating that gender differences across reading and related skills were negligible at pre- and post-test. There was very little difference between boys and girls at either program completion or commencement.

Reading gains by gender were then calculated. Table 2 presents the mean gains made by boys and girls on all six measures, as well as effect sizes for gains. Both boys and girls made

statistically significant gains across all literacy measures ($p<.001$), and these gains were very large. Effect sizes for these gains ranged from .83 to 1.21 for boys, and .85 to 1.25 for girls, indicating similar gains for both boys and girls.

Table 2

Effect Sizes of gains across literacy variables, by gender

Literacy Variable	Boys' Gains	ES (*d*)	Girls' Gains	ES (*d*)
Neale Accuracy	14.77		14.27	
Neale Comp	4.50		4.35	
Burt	12.81		13.01	
WARP (wcpm)	38.16		37.90	
SAST	6.27		6.10	
Martin & Pratt	9.81		11.28	

Data were then analysed to determine whether girls' gains were significantly higher than boys' gains on any of the literacy variables. Analyses of covariance of scores at post-test (covarying pre-test scores) revealed no statistically significant differences between boys and girls on mean gains made on any of the measures. Effect sizes (partial eta squared) for differences in these gains were extremely small, ranging from .000 to .015. The actual gains made by boys and girls were very similar after 18 weeks of intervention (see Figure 1).

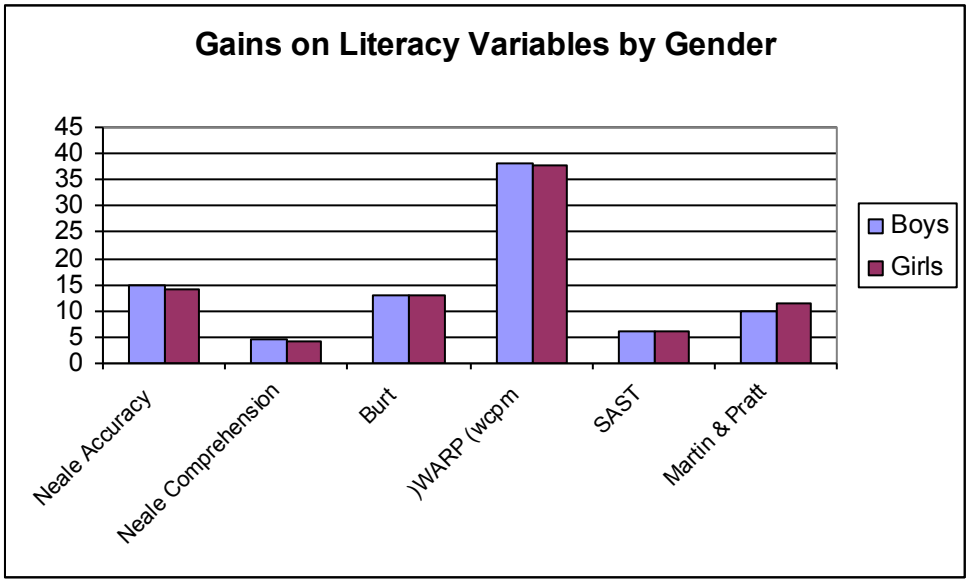

Figure 1. Gains on Literacy Variables by Gender

Discussion

The purpose of this study was to compare reading gains made by boys and girls using a proven remedial reading program, the MultiLit Program, and to determine whether boys require a different form of reading instruction.

At the commencement of the MultiLit Program, girls scored only slightly higher than boys on the six measures, but these differences only reached statistical significance on the WARP (oral reading fluency) and SAST (spelling). The effect size for all measures pre-test was small, however. Given that the sample was referred, these pre-test differences do not necessarily reflect gender differences in these abilities. At post-test, however, where any emerging gender differences would be evident, the only statistically significant mean difference was in spelling performance. There were no other statistically significant gender differences in any of the other reading and related abilities. Effect sizes for all measures post-test, including spelling performance, were very small, indicating only very small

differences between boys and girls. These findings are consistent with previous research demonstrating small or negligible gender differences in various facets of reading including oral reading fluency (Hirvonen et al., 2009; Limbrick, Madelaine, & Wheldall, submitted; Speece & Pericola Case, 2001), phonological awareness (Moura, Mezzomo, & Cielo, 2008; Papadopoulos, Spanoudis, & Kendeou, 2009; Phillips et al., 2007; Savage & Carless, 2004; Speece & Pericola Case, 2001), and reading comprehension (Lepola, 2004; Onatsu-Arvilommi & Nurmi, 2000; Prior et al., 1995).

Both boys and girls made very similar reading progress (gains) following the intervention. Boys and girls did not statistically differ in gains on any of the reading or related skills including reading accuracy, reading comprehension, single word recognition skills, oral reading fluency, spelling, or phonological recoding ability. Boys did not particularly struggle with any facet of reading. On the contrary, both boys and girls made almost identical gains in reading accuracy (14 months), reading comprehension (9 months) and individual word reading skills (17 months and 18 months respectively), and very similar gains in spelling (14 months and 16 months respectively). Larger gender differences were evident in phonological recoding ability (26 months and 39 months respectively), but this was a result of only two raw score points. Overall, gains by both boys and girls were very similar.

Previous reading programs designed for boys have commonly been founded on explanations or hypotheses for reported gender gaps in reading, such as gender differences in motivation (Atkinson, 2009; Dahlhauser, 2003; Gaynor & Stephen, 2006), reading preferences (Farris et al., 2009; Hall & Coles, 1997; Moss, 2000), behaviour (Dos Santos Ellas et al., 2003), learning styles (Logan & Johnston, 2009), computers and technology

(Leino & Malin, 2006; Littleton et al., 2006) and so forth. The results in this study did not support the need for different approaches for boys. Conversely, our findings concur with recommendations made by national inquiries in Australia (House of Representatives, 2002), the United States (National Reading Panel, 2000) and the UK (Rose, 2009). All students, irrespective of gender and background, require solid instruction in critical aspects of reading, including phonemic awareness, phonics, fluency, vocabulary and comprehension.

Although other factors have been demonstrated to affect reading outcomes, such as socioeconomic status (Fluss et al., 2009; Strand et al., 2006), the findings in this study do not suggest that gender is a strong or consistent predictor of reading achievement, but instead are consistent with a growing body of research suggesting that differences between boys and girls are in fact negligible (Hyde, 2005; Limbrick et al., 2011; Strand et al., 2006). Others have also demonstrated that reading is an area of gender-equivalence rather than gender-difference (Savage & Carless, 2004), and boys and girls are equally responsive to intervention (Linklater et al., 2009). Reported effect sizes among studies have also been frequently small, indicating that boys and girls are more similar than dissimilar in reading and related skills (see Hyde, 2005). Even on large-scale assessments such as the NAPLAN, the prevalence of boys not reaching national benchmarks is not as large as previously thought (see, for example, Limbrick et al., 2010; Wheldall & Limbrick, 2010).

The fact that many more boys than girls have been previously reported to be low-progress readers, then, may not be due to actual differences in reading ability, but rather, other factors, such as the use of referred samples. Evidence suggests that there are many more boys in referred samples compared to population samples (Flannery et al., 2000; Hawke, Wadsworth, Olson, & DeFries, 2007; Liederman et al., 2005), and because many

studies employ referred samples, it has therefore been assumed that many more boys have reading problems (Hawke et al., 2007; Liederman et al., 2005; Shaywitz, Shaywitz, Fletcher, & Escobar, 1990; Smart, Prior, Sanson, & Oberklaid, 2001).

Another factor to consider, particularly when examining the number of boys and girls not meeting national standards on large-scale assessments, is the variability of scores for boys and girls. Although this trend was not statistically significant in this study, recent studies have demonstrated that boys tend to have a greater variability in scores compared to girls (Hawke, Olson, Wilcut, Wadsworth, & DeFries, 2009; Machin & Pekkarinen, 2008) and as a result, more boys are identified as low-progress readers (Lynn & Mikk, 2009). Accordingly, it is possible that more boys are scoring in the bottom of the distribution not due to differences in mean reading scores, but rather, differences in the *variability* of scores. Recently, Machin and Pekkarinen (2008) found that boys demonstrated greater variability than girls on the PISA across most participating countries, and concluded that the greater percentage of boys scoring in the bottom 5% in reading is a result of boys' greater variability. As indicated by Lohman and Lakin (2009), the majority of studies and inquiries have largely focused on mean differences between boys and girls, but the analysis of variability, as well as means, would have considerable implications for interpreting the performance of boys and girls on assessments such as the NAPLAN, PISA and PAEP.

A limitation of this study in relation to the reporting of gain scores is the lack of control group. It is not possible to know whether the gains reported in this study are an effect of the MultiLit Program or resultant of other factors. This, however, is not the purpose of the study. The purpose was to look for differences in responsiveness of girls and girls to remedial instruction.

Conclusion

This study compared reading gains for boys and girls following participation in the Schoolwise MultiLit Program, an empirically-based reading program. Boys and girls made very similar progress in reading with MultiLit, as evidenced by performance on the range of reading and related assessments administered pre- and post-intervention. There was no supporting evidence from this study to indicate that boys and girls require different forms of reading instruction or remediation. Both low-progress boys and girls made the same gains when administered a reading program of proven efficacy, with less focus on the possible underlying causes of poor reading and greater attention on evidence-based best practices in reading. Consequently, governments, researchers and educators alike who are concerned about the educational outcomes for boys (as well as girls) are challenged to consider delivering reading programs that embody the critical aspects of reading to all low-progress readers regardless of gender.

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Table 1

Pre- and Post-Test Means and Standard Deviations for the Literacy Variables for Boys and Girls

Statistical Significance and Effect Size of Means and Standard Deviations across two testing points, by gender

	Pre-Test					Post-Test				
	Boys	Girls	t	p	*d*	Boys	Girls	t	p	*d*
Neale (Accuracy)	34.68 (11.66)	36.79 (10.61)	1.833	0.068	0.19	49.45 (14.51)	51.06 (14.00)	1.099	0.272	0.11
Neale (Comp)	11.2 (4.87)	11.4 (4.73)	0.397	0.692	0.04	15.7 (5.91)	15.75 (5.57)	0.088	0.93	0.01
Burt	47.86 (13.04)	48.02 (12.42)	0.123	0.902	0.01	60.67 (15.46)	61.03 (13.90)	0.234	0.815	0.02
WARP	78.94 (30.37)	87.35 (30.45)	2.701	.007*	0.28	117.1 (32.75)	125.25 (30.26)	2.505	0.013	0.26
SAST	28.69 (5.81)	31.04 (5.52)	4.034	.000*	0.41	34.96 (5.23)	37.14 (5.44)	4.002	.000*	0.41
Martin & Pratt	18.58 (8.78)	18.75 (8.02)	0.199	0.842	0.02	28.39 (8.62)	30.03 (7.41)	1.954	0.051	0.2

* Significant at .01 level

CHAPTER 9: CONCLUSION

Throughout the literature it has been widely reported that there are more boys than girls who are poor readers, but to date there is little consensus as to the degree to which there might be more boys. A number of factors have contributed to the inconsistencies in reported gender ratios for poor readers, the most prevalent relating to the lack of consistency in defining what it means to be a poor reader. In previous years discrepancies in the definition of poor reading have arisen theoretically (for example, whether poor reading is viewed from a behavioural perspective, motivational perspective, cognitive processing perspective, neurological perspective) and in practice (for example, whether poor reading defined by methods of low achievement, discrepancy formulae, Response-To-Intervention). Methodologically, gender differences in poor reading have also arisen when applying different severities of selection (cut-off points), as well as methods of sample selection. Identifying the true prevalence of boys with reading difficulties has been further hindered by differences across studies in the actual assessments administered, the reading skills measured, and the interpretation of results (for example, whether means only, or means and standard deviations together, were analysed). Collectively, these issues and themes surrounding the prevalence of boys identified as poor readers have not only resulted in a lack of coherent research as to whether there really are more boys than girls who struggle with reading, but presents an unclear picture of whether there are genuine differences, or merely artificially inflated differences, between boys and girls in reading. The main purpose of this program of study has been to investigate each of these major themes and issues, upon which a comprehensive theoretical framework was built in order to examine whether there are genuine differences between boys and girls, and investigate

methods of calculating accurate gender differences poor reading. Overall findings in this thesis will therefore be discussed in light of these themes and issues, and how research progressed as these different themes and issues were addressed. Implications for policy and practice, based on the findings of this research, will also be discussed.

One of the major issues identified in the field of special education is the lack of consensus in defining and measuring poor reading. Studies have differed in terms of theoretical perspective (for example, behaviour, motivation, cognitive processing, neurology), terminology (for example, reading disability, poor reading, learning disability, specific learning difficulty, etc), methods of identification (for example, low achievement, discrepancy formulae, Response-To-Intervention), severity of selection (variations in cut-off points such as standard deviations, percentile ranks) and analysis of results (analysis by means and/or standard deviations, effect sizes). This has resulted in large variances among studies in terms of exactly *what* is being measured, and *how* it is being measured. Establishing whether there are more boys than girls who struggle with reading, therefore, needed to commence with an examination of these major issues, particularly in determining whether reported gender differences may be affected by methodological factors. Consequently, an in-depth examination of these major issues was the inaugural piece of research conducted in this study (Chapter 2). In this Chapter it was confirmed that variances in the definition and measurement of poor reading directly influenced the variances in reported gender ratios for poor reading. Methodological factors including assessment, severity of selection, sample selection, the frequent use of referred samples, and methods used to identify poor readers have clearly contributed to the over-estimation of boys identified as poor readers. It was established that there is a distinction between

whether there are more boys than girls who struggle with reading, as opposed to whether there is little difference between boys and girls in reading but more boys are *identified* as poor readers as a result of these factors. This in-depth examination of the factors affecting gender ratios for poor reading (particularly factors relatively unexplored such as the variability of boys' scores), and recognising the degree to which these factors have directly affected gender ratios for poor reading, is an important contribution to existing knowledge because it sheds new light on the controversy surrounding gender and the identification of poor readers. Subsequent studies in this research (Chapters 2 to 8 inclusive) were designed and conducted in light of these findings.

Although it appeared in Chapter 2 that discrepancies among reported gender ratios were resultant of methodological differences across studies, the possibility still remained that gender differences arose due to other factors (for example, behaviour). Throughout the years there have been a number of proposed explanations to account for gender differences in reading, however, the empirical evidence supporting these explanations had not previously been examined in-depth. It was appropriate, therefore, before an empirical studies were conducted, to investigate the most common reasons attributed to gender differences in reading. If one explanation *did* adequately account for gender differences, this would have implications not only for subsequent research in this thesis but, given the increasing interest throughout existing literature regarding remediation for boys (see, for example, Logan & Johnston, 2009; Palmer, 2008; Sokal, Katz, Chaszewski, & Wojcik, 2007), there would be future implications for the development of effective programs based on empirical evidence. The review in Chapter 3 advanced existing knowledge by examining in-depth the evidence supporting six of the most common explanations

proposed to account for reported gender differences in reading, including phonemic awareness, auditory processing, problem behaviour, neurology, variability in cognitive ability and reading motivation. It was found that although these factors play a role in reading generally, none could adequately and consistently account for reported gender differences in reading. Differences in reported gender ratios appeared to be resultant of methodology, then, rather than other factors. These findings are important in the field of special education because they shed light on the widely held belief that poor reading is largely a male phenomenon.

Having examined some key issues affecting reported gender ratios for poor reading, and clarified that no single explanation appears to account for variances across studies, the question of how best to define and measure poor reading could then be addressed. As already indicated there has been a lack of consensus in the field of special education in defining and measuring poor reading, and inconsistencies across studies have resulted in inconsistencies across reported gender ratios. As discussed in Chapter 2, throughout the literature different studies have employed different methods of identification, the most common methods being low achievement, discrepancy formulae and Response-To-Intervention. To date the most common method of identification has been discrepancy formulae, but as suggested in more recent years (Siegel & Smythe, 2005), there are serious methodological flaws with this approach. Furthermore, severities of selection within these have also widely varied across studies, which have enormous implications for reported gender ratios. For example, research suggests that more boys score in the very tail of the distribution (Flannery, Liederman, Daly, & Schultz, 2000; Share & Silva, 2003; Stevenson, 1992), and consequently more stringent severities of selection will yield greater gender

ratios for poor reading. If accurate gender ratios for poor reading were to be reported in this thesis, then a consistent and widely accepted measure of defining poor reading needed to be identified. Research was subsequently conducted to address this need (Chapters 4 and 5).

As outlined in Chapter 2, a number of methodological factors can affect reported gender ratios, such as the method used to define poor reading, the assessment administered, severity of selection, and sample selection. As a result, in Chapter 2 it was recommended that a cautious approach to identifying poor readers may be to employ a population sample and apply a method of identification which isolates the tail end of the distribution, which takes into account the continuous nature of reading ability (Coltheart & Prior, 2007). This approach is less likely to be subject to systematic bias, and the use of a population sample reduces the likelihood of gender bias in sample selection. This recommendation, based on empirical research, guided the development of studies presented in Chapters 4 and 5 by investigating the use of large-scale assessments in generating gender ratios for poor reading. In this thesis the advantage of large-scale assessments is that they meet the recommendations in Chapter 2 by providing a single measure of reading to which a standard severity of selection can be applied to define poor reading. They are objective and normed (Sloane & Kelly, 2003), and it is clear exactly which reading skill is being measured. This approach, in effect, defines en masse *what* is being measured, and *how* it is being measured, thereby controlling for the inconsistencies reported throughout the literature. Furthermore, because large-scale assessments are administered to whole populations, they also address the issue of sampling bias. In Chapters 4 and 5, data on primary school students participating in the New South Wales Basic Skills Test (BST)

between the years 1997 and 2006, and the NAPLAN throughout Australia in 2008, were analysed by gender. Results of these studies indicated that, on a measure of reading comprehension, there were more boys than girls identified as poor readers, but there was not a preponderance of boys identified. Moreover, effect sizes reported in Chapter 5 indicate that differences between boys and girls in reading means were relatively small. Chapter 5 also reported gender ratios for poor reading for an entire country, which had not been previously done in Australia. Together, Chapters 4 and 5 advance existing research by demonstrating how population benchmark reading measures can be used to examine gender differences in poor reading. It offers an alternative approach to addressing the controversy surrounding the definition and measurement of poor reading, particularly in the absence of an agreed-upon definition of what it means to be a poor reader.

As research progressed, other identified issues with respect to gender ratios for poor reading were examined in more detail. One such issue was the use of different measures of reading, and subsequently reading skills measured. The BST and NAPLAN had measured reading comprehension, but the question then arose of whether gender ratios for poor reading would vary depending on the reading skill measured. Indeed, within the existing body of literature an unclear picture had emerged regarding whether or not boys and girls differ in various facets of reading. There was some limited research investigating this (Prochnow, Tunmer, Chapman, & Greaney, 2001), however, most studies focused on one, or two, aspects of reading. As such, variances across previous studies had rendered it difficult to ascertain whether reported gender differences were due to actual differences in reading skills in addition to differences in methodological factors. Unlike the study by Prochnow et al. (2001), however, which tested for gender differences across a number of

reading and related assessments, one of the purposes of this study was to clarify whether gender ratios for poor reading varied by reading assessment (and subsequently skill measured). This was achieved by administering a range of reading and reading-related assessments to a single population, and examining gender ratios for poor performance by a method of low achievement (as clarified in Chapter 2). In terms of gender ratios for poor reading, it was found that ratios varied slightly by reading skill in the early school years (Chapter 7), but were not always in favour of girls. In Year 1, there were several instances were more girls than boys were identified as poor readers. It was evident, however, that gender ratios increased from Year 1 to Year 2. In the primary school years, gender ratios in reading comprehension also varied with years of schooling (Chapter 4), increasing from Year 3 to Year 5. The reasons for increasing gender ratios over time are not clear. In Chapter 7 it was hypothesised that more boys are identified as poor readers because, in some instances, boys' behaviour might not always be a good 'fit' with the school environment (Entwistle, Alexander, & Olson, 2007), and more boys were identified because of their behaviour (Prochnow et al., 2001). This hypothesis remains untested, however, as behaviour was not examined in this research.

In terms of mean scores, the overall findings in this study are consistent with others who reported that there are few gender differences in various aspects of reading (Prochnow et al., 2007; Siegel & Smythe, 2005). It was found that gender differences in reading comprehension were very small, as evidenced by small effect sizes (Chapter 5). It was also identified that oral reading fluency (Chapter 6) was a domain of gender equivalence rather than gender difference, likewise evidenced by very small effect sizes for differences in means as well as rates of progress. Similar findings were further reported for a sample of

referred students in the upper primary years (Chapter 8). Boys and girls who were already identified as poor readers made the same progress in reading when participating in a remedial reading program, as evidenced by pre- and post-test results on measures of reading accuracy, reading comprehension, single word recognition, oral reading fluency, spelling and phonological recoding. It was found that boys and girls did not differ in means or rates of progress (gains) in different facets of reading. This trend was also apparent in the early school years (Chapter 7) on measures of word and non-word reading, phonological recoding ability, phonological awareness, reading fluency, single word verbal ability, and spelling. These findings add clarity to the field of special education by establishing that boys and girls do not largely vary in different facets of reading.

The importance of severity of selection in reporting gender ratios was an issue that frequently arose as research progressed. As previous studies have demonstrated, there are more boys than girls in the tail of the distribution (Flannery, Liederman, Daly, & Schultz, 2000; Share & Silva, 2003) and consequently different severities of selection may yield different gender ratios for poor reading. In other words, the more stringent the severity of selection, the greater the gender ratio. This phenomenon was tested in Chapters 4 and 5. Two definitions of poor reading were administered; initially to take into account the continuous nature of reading ability (Siegel & Smythe, 2005), but it also served to enable examination the relationship between severity of selection and reported gender ratios. In both Chapters 4 and 5, gender ratios were larger with the more stringent severities of selection, adding weight to the idea that gender ratios for poor reading are directly affected by severity of selection. This has enormous implications for reporting gender ratios for

poor reading and, in terms of policy and practice, determining the point at which remediation is required.

The question of *why* there were more boys in the tail of the distribution led to an examination of the distribution of reading scores for boys and girls. Did boys and girls have different distributions of scores, or did girls have superior reading scores generally? Of particular interest was a line of research which advocates that more boys score in the tail of the distribution because boys achieve greater variability in scores compared to girls (Hawke, Olson, Willcut, Wadsworth, & DeFries, 2009). Furthermore, at the time of this research, it was unknown whether boys demonstrate greater variability than girls across different facets of reading, and if so, to what degree. Hawke et al. reported on reading generally based on measures of reading recognition, reading comprehension and spelling. Others have reported on boys' variability based on measures of reading comprehension (Machin & Pekkarinen, 2008). What had not been clarified was whether boys demonstrate different *degrees* of variability across different reading skills. This would have implications not only for reported gender ratios for poor reading (depending on which reading skills are measured) but also for the severity of selection applied. These unanswered questions framed, in part, the design of several studies in this research.

On measures of reading comprehension (Chapter 4) and oral reading fluency (Chapter 6), there was some evidence to suggest that boys demonstrated greater variability in scores, but in the majority of instances the differences in variability between boys and girls were not significant. The research in this thesis also questioned whether the variability of boys' scores was affected by age or years of schooling. Building on Hawke et al.'s findings, a study was conducted to ascertain whether boys demonstrated greater variability across a

range of reading and related abilities in the early school years (Chapter 7). It was found that on measures of word and non-word reading, phonological recoding ability, phonological awareness, reading fluency, single word verbal ability, and spelling, there was only very limited evidence for boys' greater variability. In word reading and spelling, boys' obtained statistically significantly greater variability in scores, but this did not appear to enlarge gender ratios for poor reading on these skills: gender ratios for these skills were reported as 1:1 and 1.05:1 respectively. It is possible, however, that the variability of boys' scores increases with years of schooling. Prochnow et al. (2001) also found little difference in the distribution of reading scores for boys and girls in the early school years, however, studies examining gender differences in older students have reported significant differences (Hawke et al., 2001).

If the variability of boys' scores increase with years of schooling, this could potentially also account for why gender ratios for poor reading increase with years of schooling. Although further research is clearly warranted, these findings nevertheless advance knowledge in the field of special education by providing new insight into the issues surrounding the variability of boys' scores, particularly with relation to different facets of reading and years of schooling.

The confirmation that there are few gender differences in various facets of reading is an important contribution to the field of special education. The findings demonstrate that boys do not have any particular weaknesses in reading and this has enormous implications for remediation. There are also implications for addressing another major issue in the field of special education, which is gender bias in methods of referral. Referral for special education services is frequently made by teachers, although studies show that boys are

more likely to be referred for special education services as a result of their behaviour (Prochnow et al., 2001; Skårbrevik, 2002). In other words, boys are more likely to display troublesome behaviour in the classroom, and this behaviour results in more frequent referrals (Beaman, Wheldall, & Kemp, 2007). Girls, on the other hand, are less disruptive and therefore less likely to be identified (Bauermeister et al., 2007; Biederman et al., 2005; Levy et al., 2005). Because many studies employ referred samples, it has been assumed that many more boys have reading problems (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990; Liederman, Kantrowitz, & Flannery 2005; Hawke, Wadsworth, Olson, & DeFries, 2007). Conversely, if boys and girls do not differ in reading skills, then identification by reading skill is less likely to be biased by gender. Chapters 4 and 5 demonstrate that only moderate gender ratios are reported when identification is based on reading skill, such as reading comprehension. One of the limitations of the large-scale assessments used in Chapters 4 and 5, though, is the fact that students are only assessed every two years and therefore early identification is not always achievable.

To address this limitation, it was deemed necessary to consider the identification of poor readers on an alternative facet of reading, oral reading fluency. Prior to this study, little research existed on gender and oral reading fluency, despite the fact that oral reading fluency is a critical aspect of reading. The advantage of measures of oral reading fluency is that they are relatively quick and easy to administer (Madelaine & Wheldall, 2005). Furthermore, they can be used to monitor the progress of poor readers once identified (Wheldall & Madelaine, 2006). Chapter 6, therefore, investigates the possibility of examining gender ratios in oral reading fluency. In this study, however, no gender differences were found in mean scores and rates of progress. These findings suggest that

all poor readers, irrespective of gender, would be identified. Chapter 6 therefore contributes to existing research by offering a practical solution to the issue of referral bias in the classroom.

Having established that there appears to be very little difference between boys and girls in various facets of reading, it raised the question of whether boys and girls require different forms of remedial reading instruction. This was important given the considerable attention on boys' educational outcomes in recent years (Center on Education Policy, 2010; House of Representatives, 2002; Ontario Ministry of Education, 2009). If reported gender differences are due largely to methodology (Chapter 2), and the most common explanations for reported gender differences do not adequately account for these differences (Chapter 3), then reading programs designed to improve boys' outcomes, which are commonly based on such explanations, may not be warranted. The fact that boys and girls achieved similar results on a range of reading and related skills (Chapters 5, 6, and 7), evidenced by small effect sizes in gender differences and almost identical rates of progress, also supported the assumption that boys do not require different remedial reading instruction. These findings shaped the hypothesis in Chapter 8 that boys and girls do not require different forms of remediation. Participants in the study were boys and girls in Years 5 and 6 who were already identified as poor readers who participated in the MultiLit ('Making Up Lost Time In Literacy') Program. The MultiLit Program is a remedial reading program which has been repeatedly demonstrated to be effective for struggling readers (Wheldall, 2009; Wheldall & Beaman, 2000, 2011). Despite the use of a referred sample in Chapter 8, boys and girls made almost identical progress in reading after 18 weeks of instruction, evidenced by pre- and post-test results across a range of assessments.

These findings advance existing knowledge by confirming that, based on empirical evidence, boys and girls do not require different forms of remedial reading instruction; they just require good instruction. It was confirmed that all struggling students, irrespective of gender, would benefit from empirically-based reading programs which embody the critical aspects of reading.

The evidence reported in this thesis confirm that when employing empirically-based research based on representative samples, particularly employing methods of identification which isolate the tail end of the distribution, only small differences between boys and girls are found in reading. It is concluded that gender not a strong or consistent predictor of reading. Based on the findings reported in this research, previously reported large gender differences are more likely due to methodological factors rather than gender differences in reading. When these factors are controlled, there does not appear to be a preponderance of boys who are poor readers. Furthermore, because gender ratios for poor reading do vary as a result of methodological factors, the findings in this research further contribute to the field of special education by underlining the importance of comprehensive analysis and interpretation of results when reporting gender differences in reading, and gender ratios for poor reading.

Implications for Policy and Practice

Throughout the literature it has been frequently reported that there are more boys than girls who are poor readers; in some instances, poor reading has been thought a male trend (Liederman et al., 2005). The findings in this research, however, demonstrate that although there are more boys than girls who are poor readers, there is not a preponderance of boys as previously reported (Liederman et al., 2005; Miles, Haslum, & Wheeler, 1998).

Furthermore, gender differences in reading appear to be relatively small. These findings have important implications for policy and practice.

Gender ratios for poor reading appear to be lower than previously reported, and evidence suggests that there are only small differences between boys and girls in reading. It is important, then, that educators rely less on factors such as behaviour, and more on actual reading performance, to ensure *all* students, irrespective of gender, are appropriately identified. This may involve establishing more objective methods of identification than what is frequently employed, for example teacher referral. Research suggests that boys are more likely to be referred for special education services as a result of their behaviour (Prochnow et al., 2001; Skårbrevik, 2002), whereas girls, being typically less disruptive, are therefore less likely to be identified (Bauermeister et al., 2007; Biederman et al., 2005; Levy et al., 2005). Identification by low achievement on assessments of oral reading fluency (which are relatively quick and easy to administer), or even by performance on large-scale assessments, may be more objective and less gender-biased. It is recommended that future policy and practice adopt objective methods of identification to ensure all struggling students receive appropriate intervention.

In this research it was also demonstrated that gender, as a variable, is not a strong or consistent predictor of reading ability. Other factors, such as low socio-economic status (Burt, Holm, & Dodd, 1999), poor phonological awareness (Savage & Carless, 2004) and behaviour (Smart et al., 2001) are more likely to affect reading performance. As such, it is recommended that educators and researchers alike focus on the factors known to affect reading outcomes rather than gender.

Finally, the findings in this research also suggest that boys and girls do not require separate forms of remediation. This has important implications for policy and practice given the large focus on educational outcomes for boys in recent years, and the considerable number of reading programs and interventions which have been developed specifically for boys. In this research, it was evident that both boys and girls make similar progress in different aspects of reading when administered an empirically-based reading intervention. There was no evidence to support the suggestion that boys require different approaches to reading. It is recommended that both boys and girls receive good instruction and/or intervention based on empirical evidence and embody the critical aspects of reading, including phonemic awareness, phonics, fluency, vocabulary and comprehension.

Conclusions

The major themes and issues identified at the commencement of this thesis formed the theoretical framework for the research conducted. In addressing these issues and themes, it appears that there may be more boys than girls who are poor readers, but not a preponderance of boys as previously reported. Moreover, previously reported differences between boys and girls in reading are more likely to be due to methodological factors rather than actual gender differences in reading ability.

In this research there were six specific research aims. The first was to examine the methodological differences across existing studies reporting gender ratios for poor reading, and to investigate the efficacy of proposed explanations to account for reported gender differences. It was found that variances in previously reported gender ratios for poor reading appear to be the result of methodological differences across existing studies rather than actual differences between boys and girls. Although a number of explanations have

been proposed to account for reported gender differences, no single explanation wholly accounts for these differences. It is concluded that gender is not a strong or consistent predictor of reading ability.

The purpose of this research was also to examine whether there was a difference in the ratio of boys and girls with reading disability, or whether girls just have superior reading skills more generally. It was concluded that, even when using methods of low achievement, standard severities of selection and population samples, more boys than girls were identified as poor readers, but the degree to which there were more boys was not as high or inconsistent as previously reported. Small effect sizes for mean differences have been frequently reported.

In terms of whether there are specific aspects of reading with which boys struggle more than girls, it was found that overall boys and girls do not largely differ in various reading and related abilities, either in benchmark assessments or rates of progress. This was evident in assessments of reading comprehension, reading accuracy, reading fluency, oral reading fluency, non-word reading skills, phonological recoding ability, phonological awareness, single word verbal ability, and spelling. Boys did not particularly struggle with any facet of reading any more than girls.

Another aim of the research was to determine whether boys demonstrated greater variability in reading scores. Consistent with previous research (Hawke et al., 2009), it was found that boys did demonstrate greater variability in reading scores across a range of reading and related abilities, but in the majority of instances this did not reach statistical significance. There was limited evidence to suggest that boys' greater variability influences gender ratios for poor reading. Although only very limited data are currently available on

the variability of boys' scores in relation to gender ratios, educators and researchers are advised to consider this phenomenon when investigating gender differences in reading.

The fifth research aim was to examine whether gender ratios of reading disability varied with age. The findings in this study confirm that gender ratios for poor reading increased with age or years of schooling. The reason for this trend is unclear, and warrants further research, but hypothetically could due to factors such as the variability of boys' scores (as discussed above) or problem behaviour. In this research, however, the role of behaviour was not examined. Future studies could examine in-depth the relationship between behaviour and gender ratios for poor reading over time.

The final research aim sought to establish whether boys and girls require different teaching and/or remediation in reading. The findings in this study suggest that boys and girls do not require separate forms of remediation in reading. In Chapter 8 it was evident that when participating in an empirically-based remedial reading program of proven efficacy, incorporating the critical aspects of reading, both boys and girls make almost identical progress.

The research reported in this thesis has made an important contribution to the field of special education. The issues relating to the prevalence of boys who are poor readers have been clearly identified, and it has been established that there is not a preponderance of boys identified when these issues have been addressed. Based on empirical evidence, it has been demonstrated that previously reported gender differences have been the result of methodological factors rather than actual differences between boys and girls in reading. Boys and girls make almost identical progress in benchmark reading performance, and also make similar and substantial gains in reading with empirically-based programs which

encompass the critical aspects of reading. Despite the focus on gender-specific reading programs and outcomes in recent years, the findings in this study support the premise that both boys and girls make the same progress with good instruction and/or programs which embody the critical aspects of reading.

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APPENDIX 1

Table 1

Significance and effect sizes for gender differences in gains made across 20 weeks, by Grade (Year of Schooling)

		F	Sig.	Partial Eta Squared
Year 2	WARP	.255	.615	.005
	SW	2.362	.130	.041
	PD	.043	.836	.001
Year 3	WARP	3.726	.060	.076
	SW	1.746	.193	.037
	PD	.033	.858	.001
Year 4	WARP	.007	.934	.000
	SW	2.395	.128	.042
	PD	.264	.610	.005
Year 5	WARP	.056	.814	.001
	SW	2.690	.108	.058
	PD	1.120	.296	.025

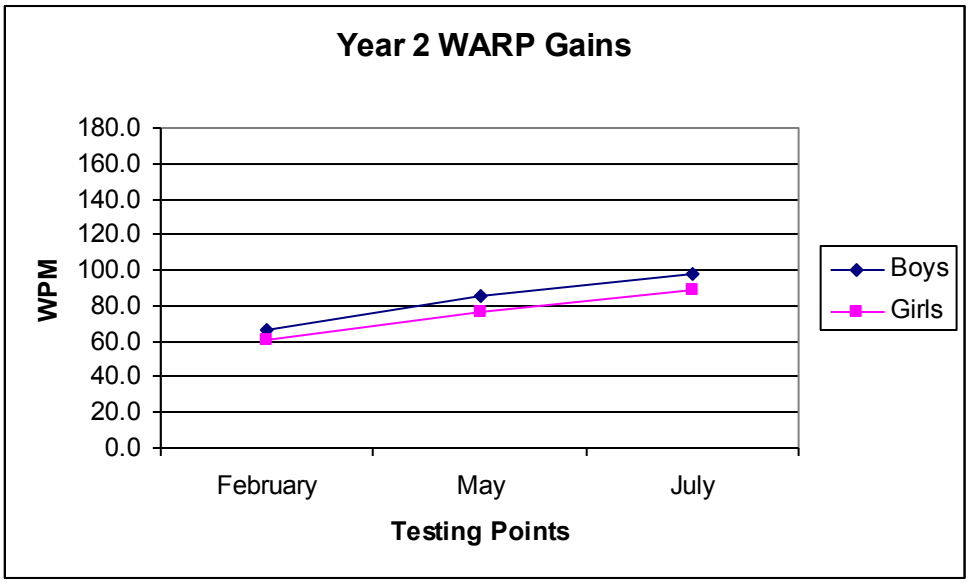

Figure 1. Average WARP means for Year 2 at three testing points (February, May and July)

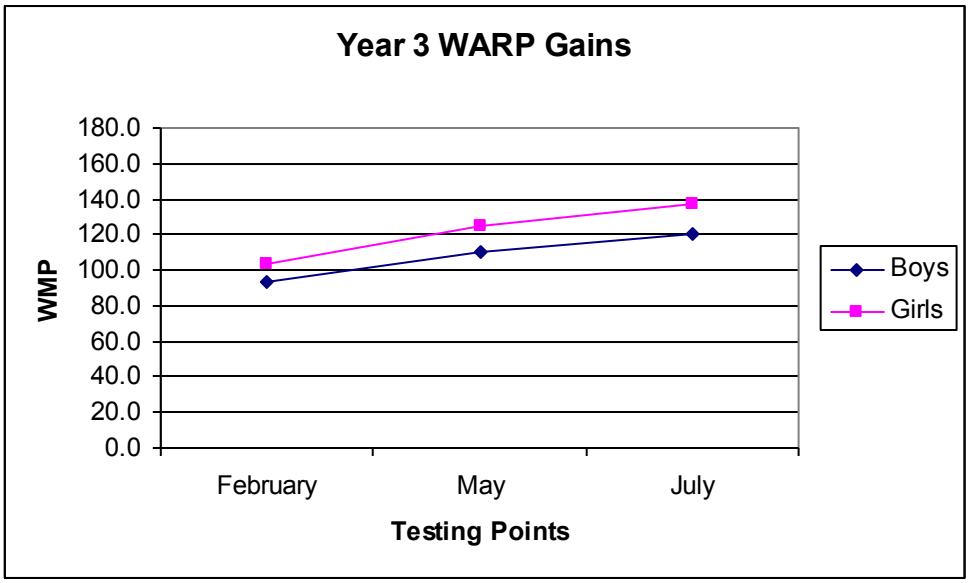

Figure 2. Average WARP means for Year 3 at three testing points (February, May and July)

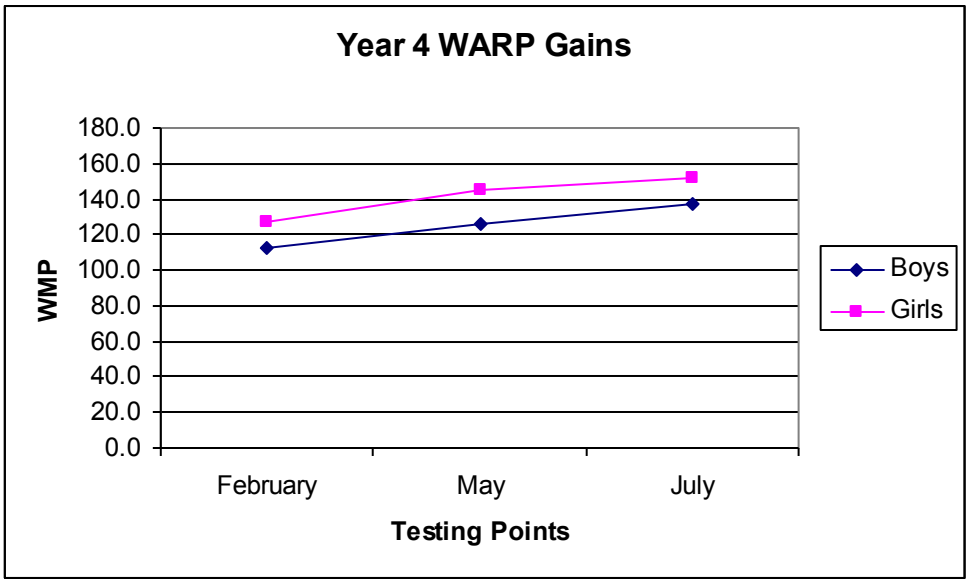

Figure 3. Average WARP means for Year 4 at three testing points (February, May and July)

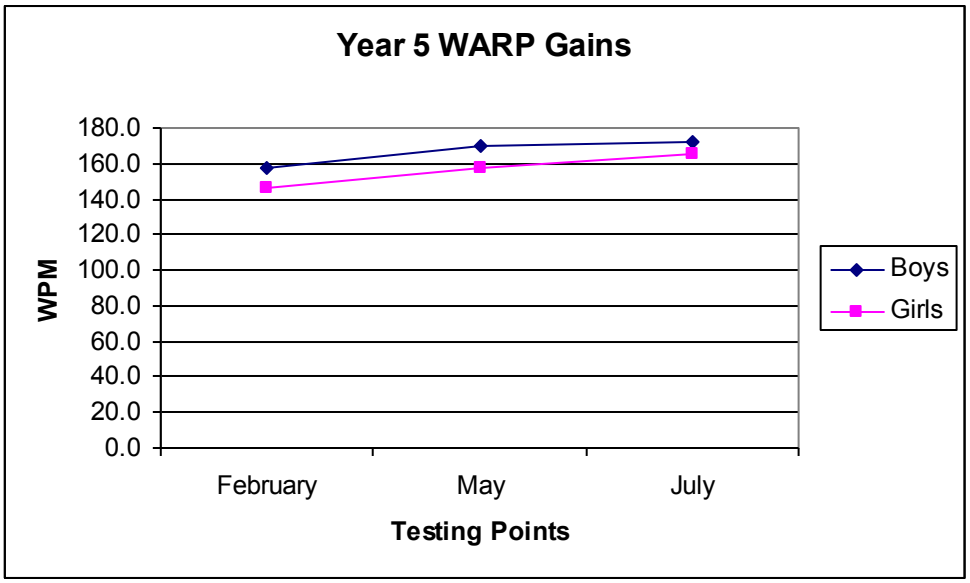

Figure 4. Average WARP means for Year 5 at three testing points (February, May and July)

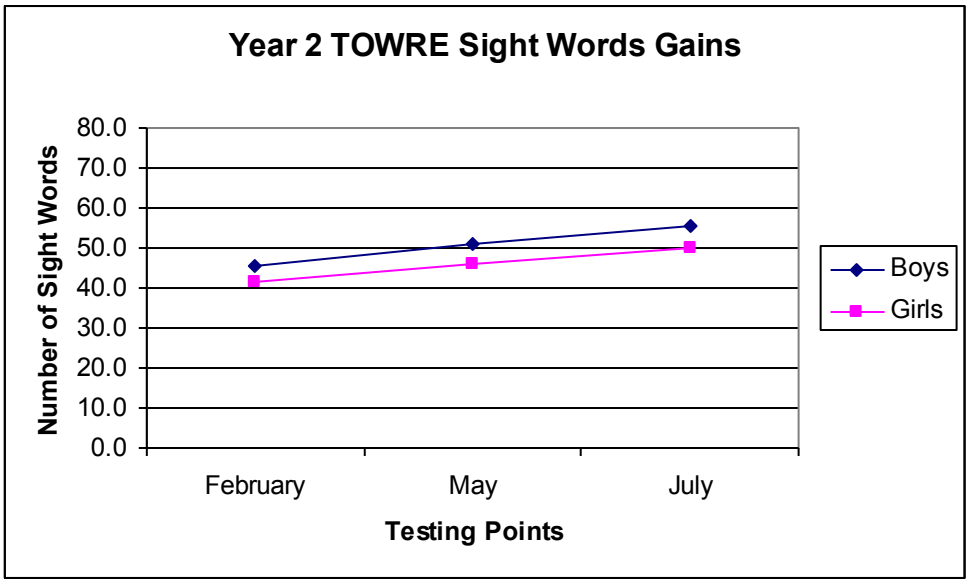

Figure 5. Average TOWRE Sight Word means for Year 2 at three testing points (February, May and July)

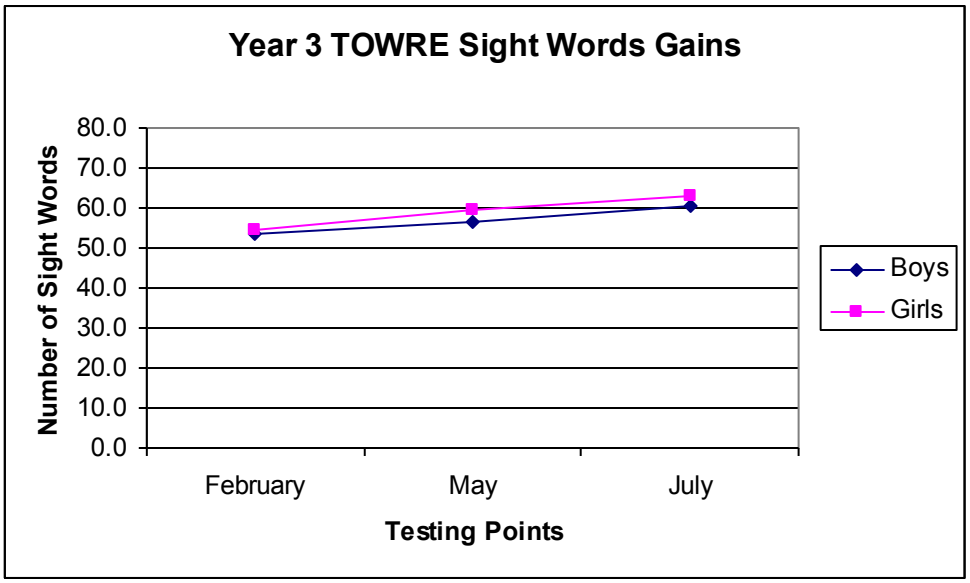

Figure 6. Average TOWRE Sight Word means for Year 3 at three testing points (February, May and July)

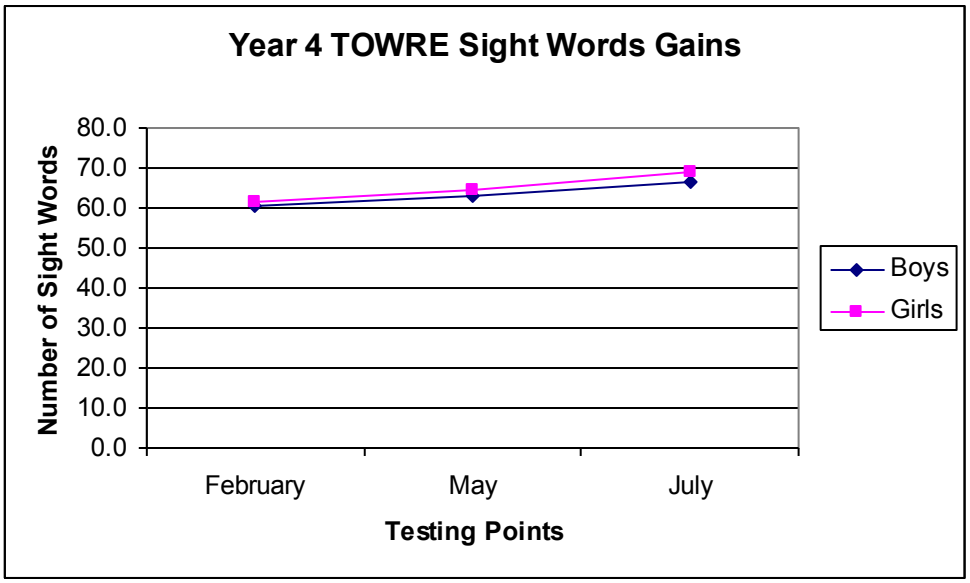

Figure 7. Average TOWRE Sight Word means for Year 4 at three testing points (February, May and July)

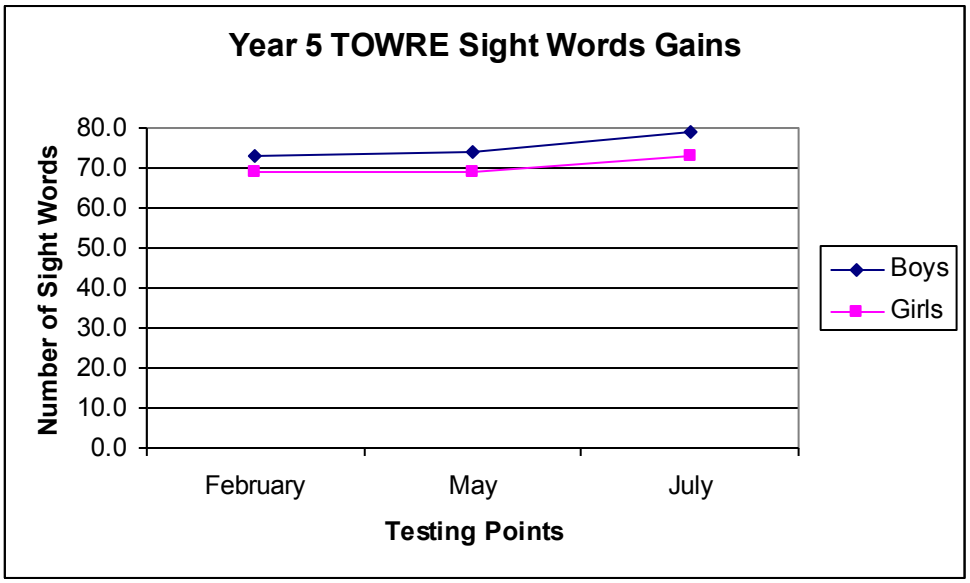

Figure 8. Average TOWRE Sight Word means for Year 5 at three testing points (February, May and July)

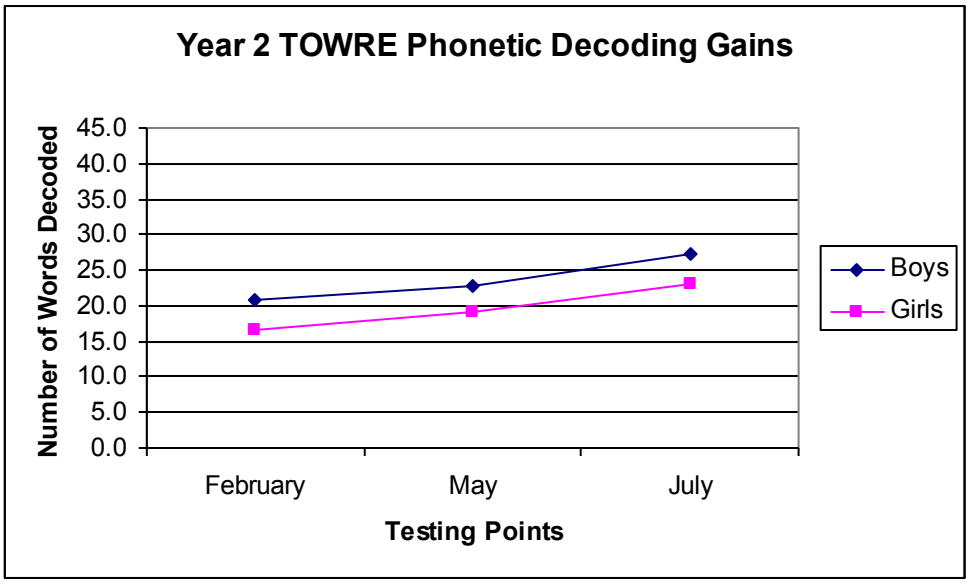

Figure 9. Average TOWRE Phonetic Decoding means for Year 2 at three testing points (February, May and July)

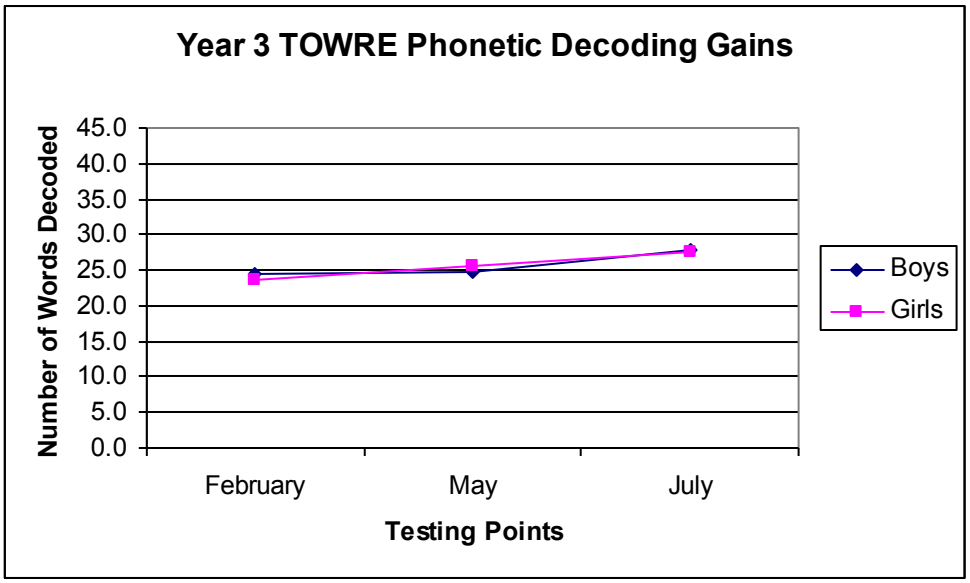

Figure 10. Average TOWRE Phonetic Decoding means for Year 3 at three testing points (February, May and July)

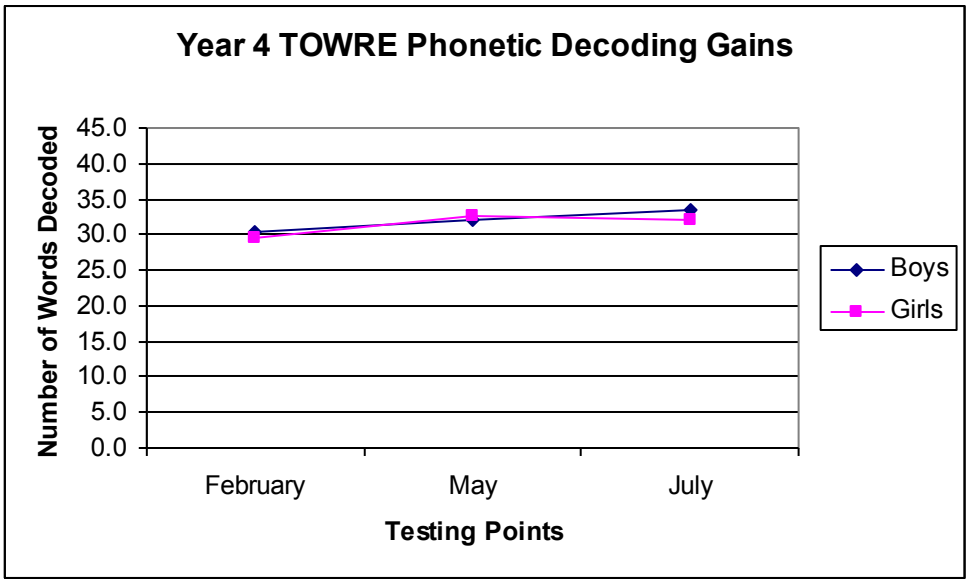

Figure 11. Average TOWRE Phonetic Decoding means for Year 4 at three testing points (February, May and July)

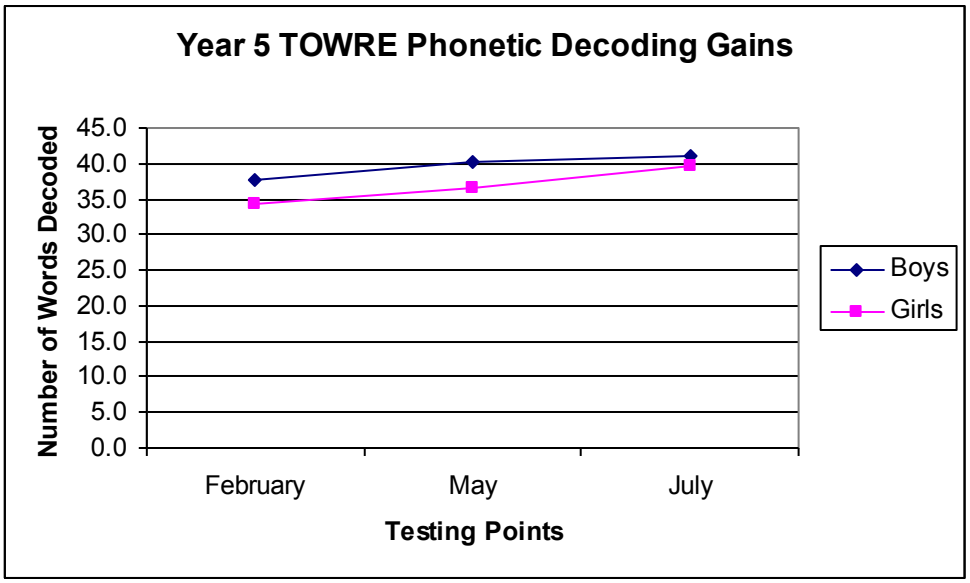

Figure 12. Average TOWRE Phonetic Decoding means for Year 5 at three testing points (February, May and July)

APPENDIX 2

Table 1

Significance and effect sizes for gender differences in gains made, by Grade (Year of Schooling)

Year (Grade)	Assessment	F	Sig.	Partial Eta Squared
Year 1	BURT	2.803	.096	.018
	Martin & Pratt	6.229	.014	.039
	WARL	1.995	.160	.013
	WARP	.086	.770	.001
	PPVT	3.173	.077	.020
	SPAT	4.100	.045	.026
	SAST	2.142	.145	.014
Year 2	BURT	5.445	.021	.033
	Martin & Pratt	.093	.761	.001
	WARL	.059	.808	.000
	WARP	2.650	.106	.018
	PPVT	9.400	.003*	.055
	SPAT	.502	.480	.003
	SAST	.383	.537	.002

* denotes significance at the .01 level

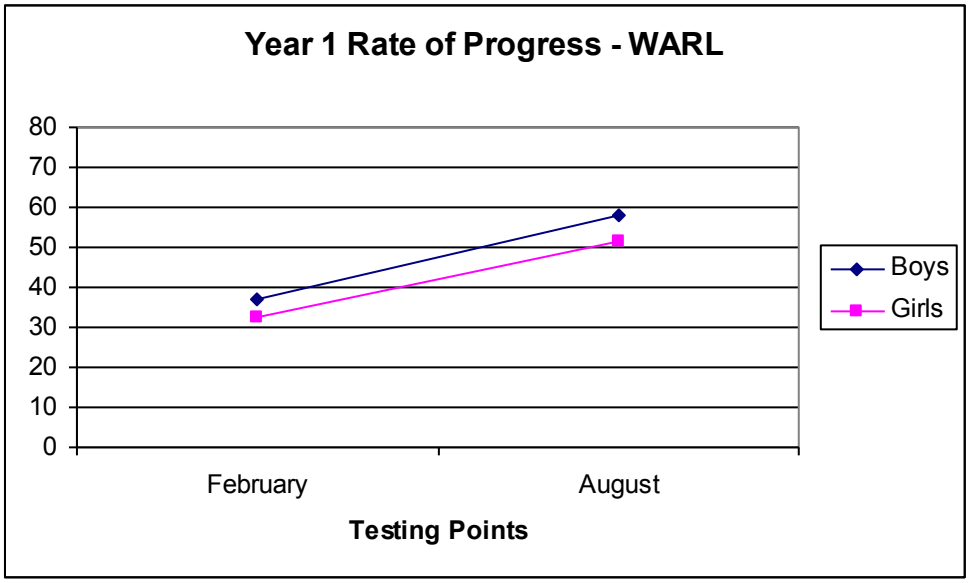

Figure 1. Oral Reading Fluency Rates of Progress on the WARL for Boys and Girls in Year 1

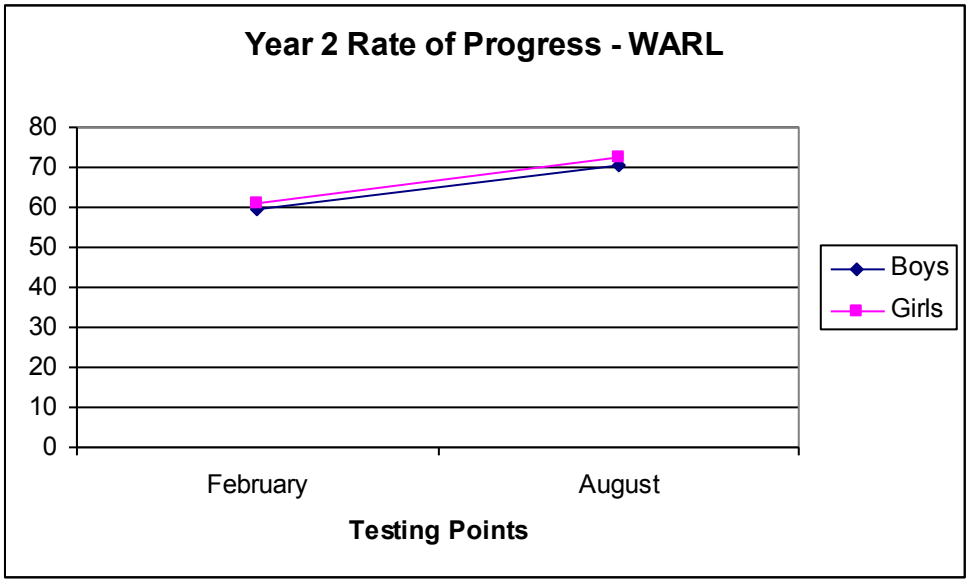

Figure 2. Oral Reading Fluency Rates of Progress on the WARL for Boys and Girls in Year 2

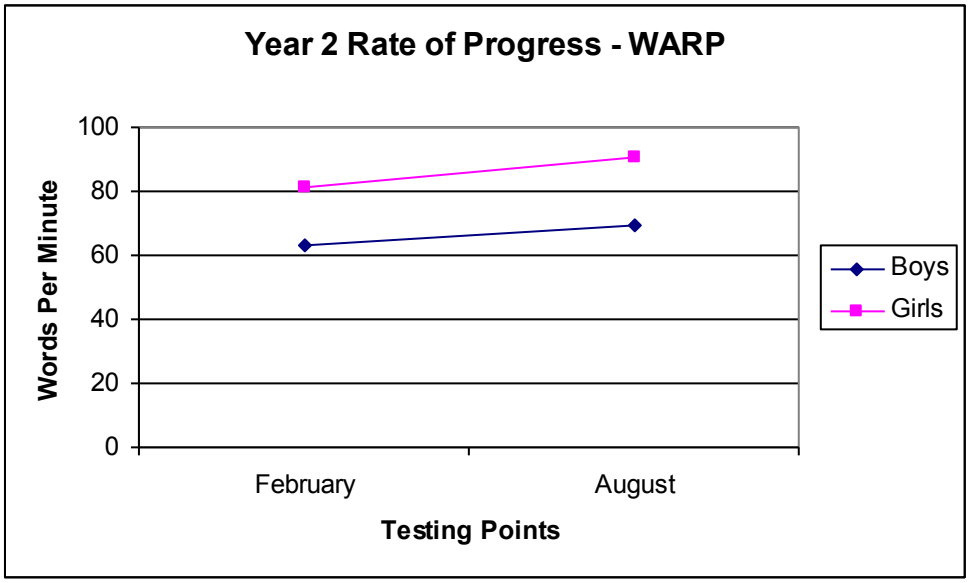

Figure 3. Oral Reading Fluency Rates of Progress on the WARP for Boys and Girls in Year 2

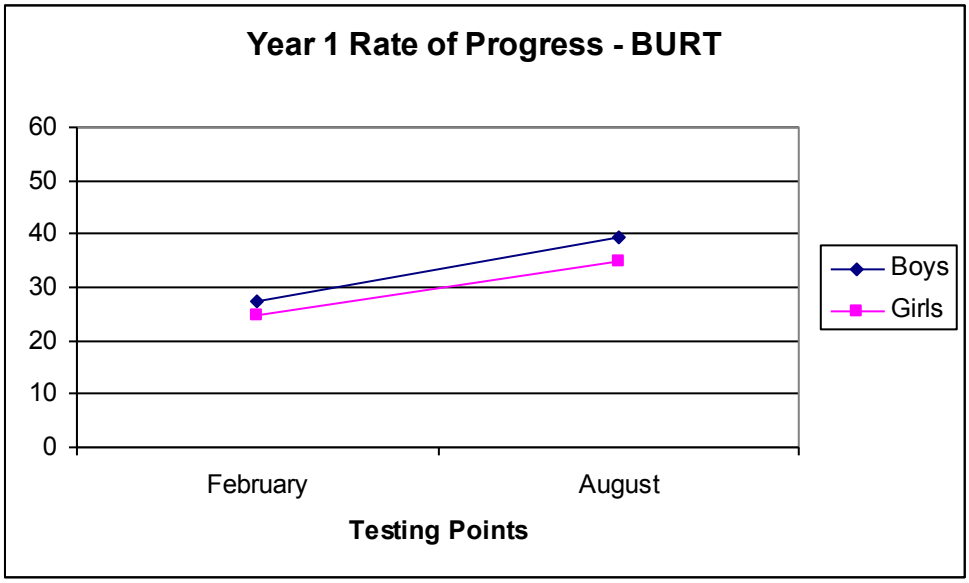

Figure 4. Rates of Progress on the BURT for Boys and Girls in Year 1

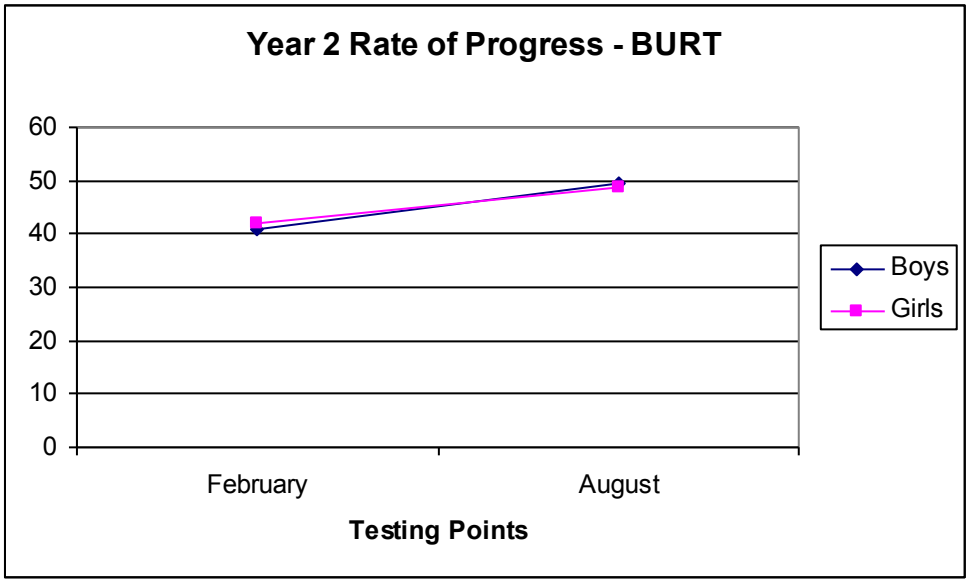

Figure 5. Rates of Progress on the BURT for Boys and Girls in Year 2

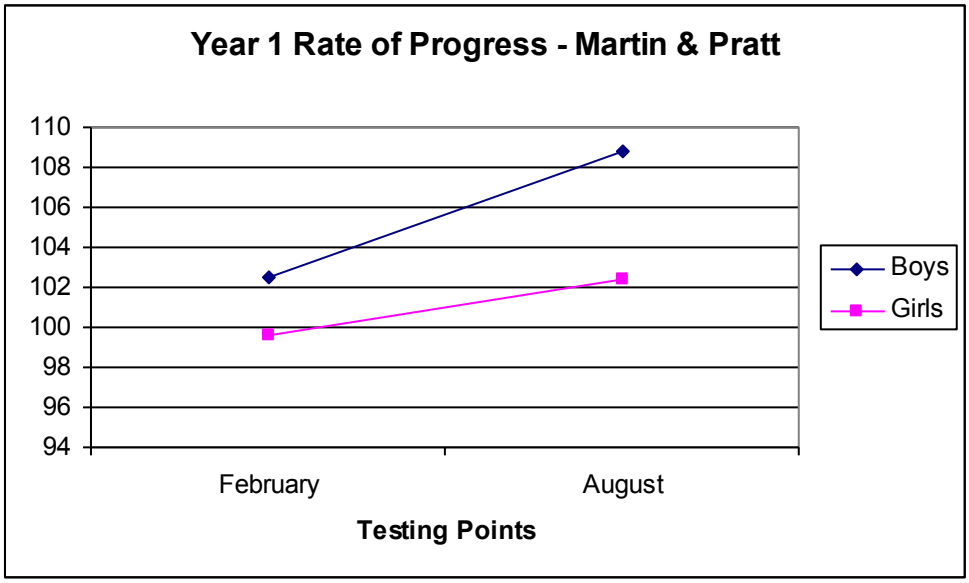

Figure 6. Rates of Progress on the M&P for Boys and Girls in Year 1

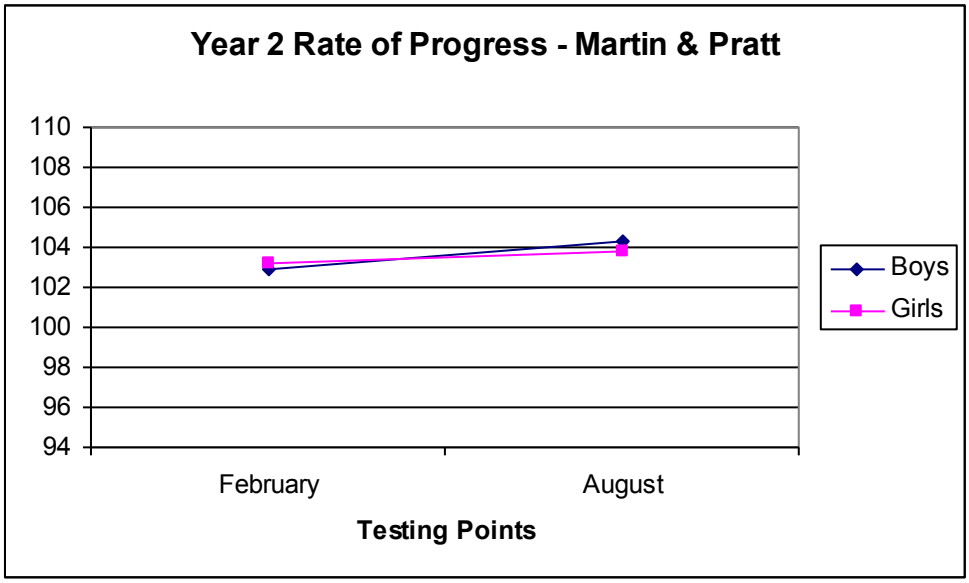

Figure 7. Rates of Progress on the M&P for Boys and Girls in Year 2

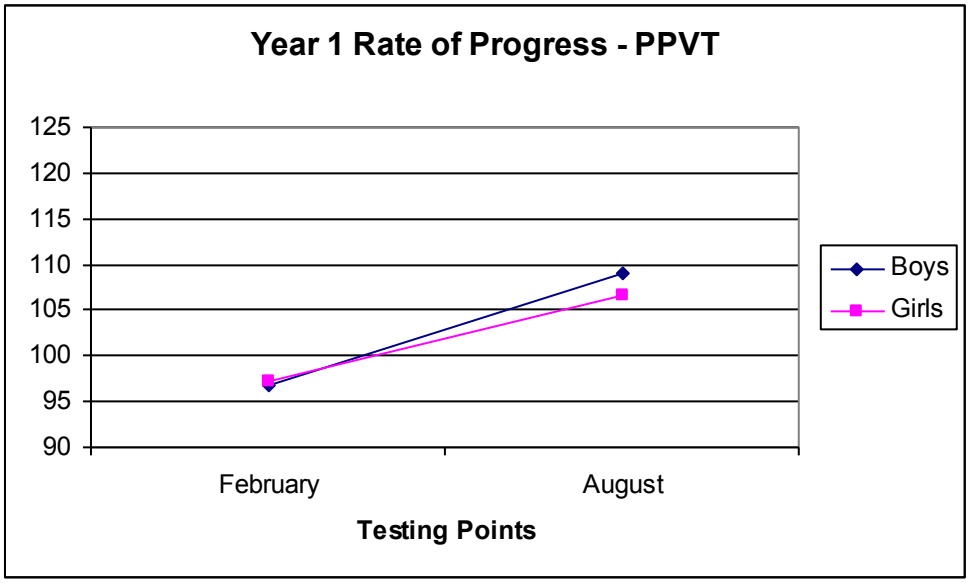

Figure 8. Rates of Progress on the PPVT for Boys and Girls in Year 1

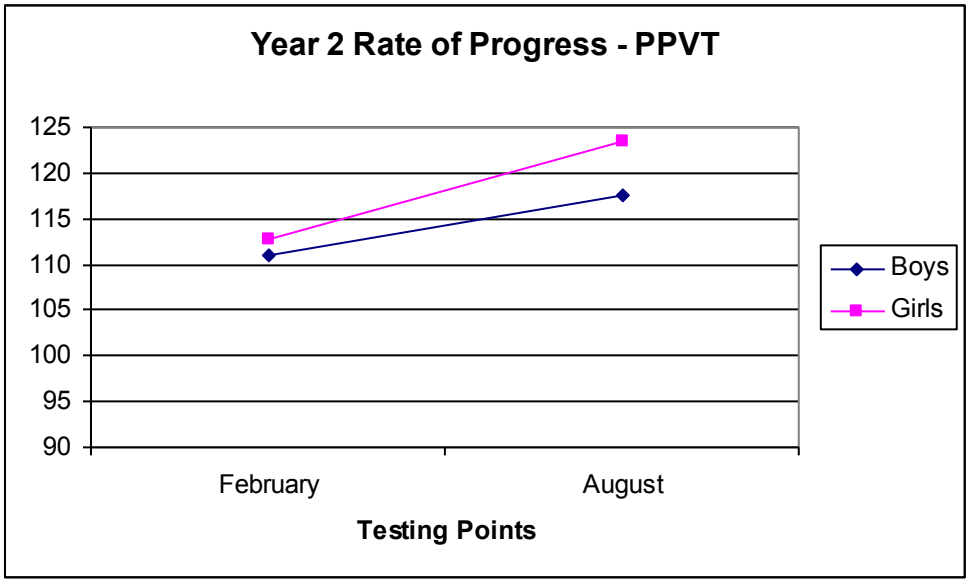

Figure 9. Rates of Progress on the PPVT for Boys and Girls in Year 2

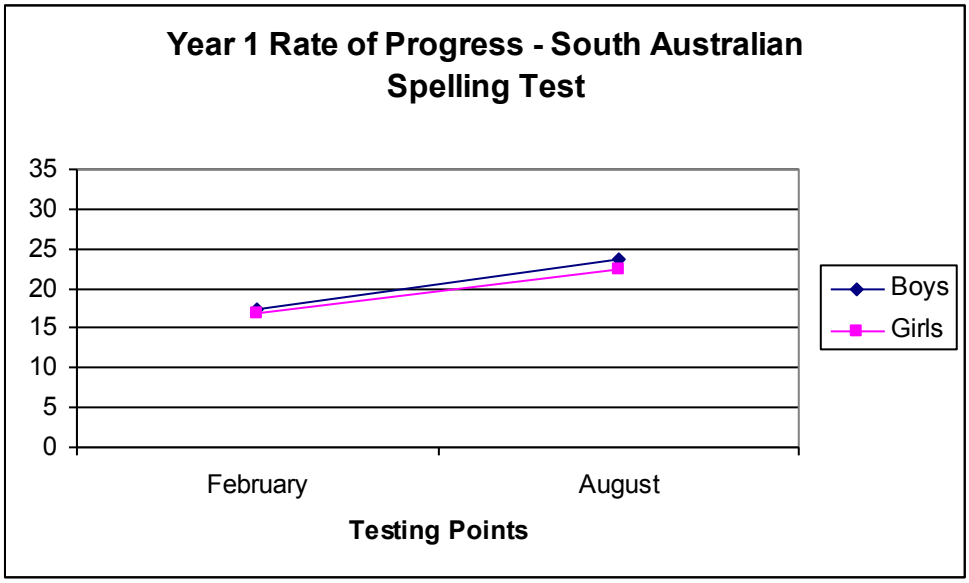

Figure 10. Rates of Progress on the SAST for Boys and Girls in Year 1

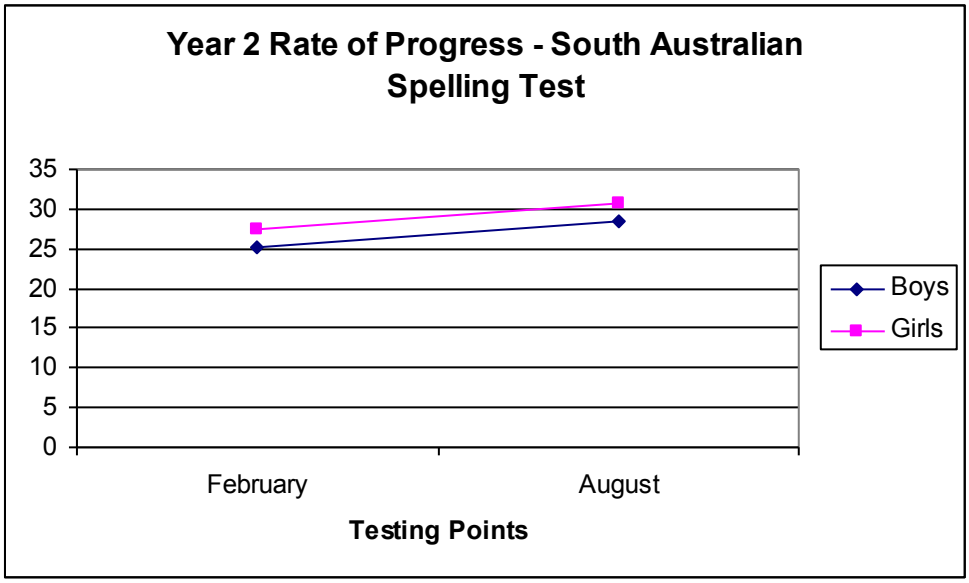

Figure 11. Rates of Progress on the SAST for Boys and Girls in Year 2

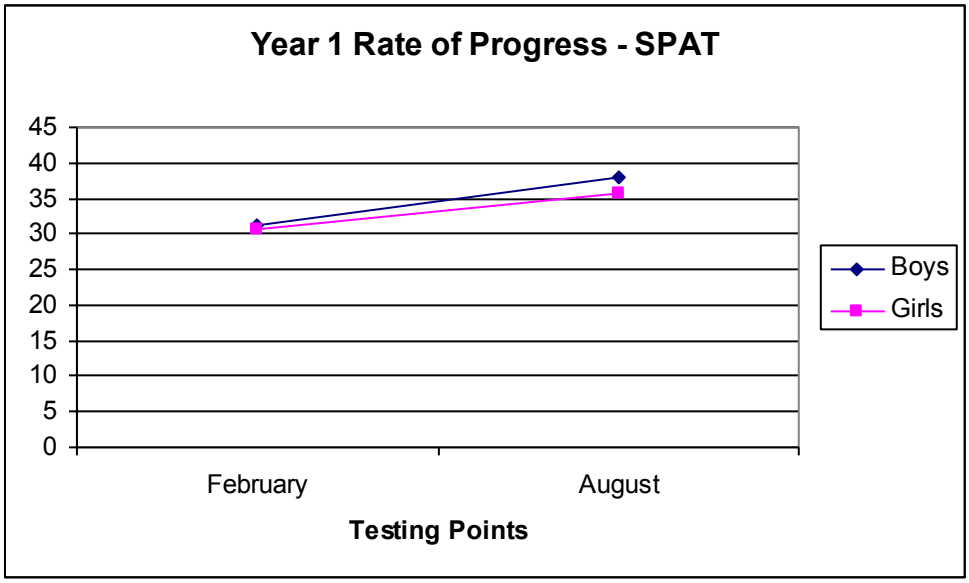

Figure 12. Rates of Progress on the SPAT for Boys and Girls in Year 1

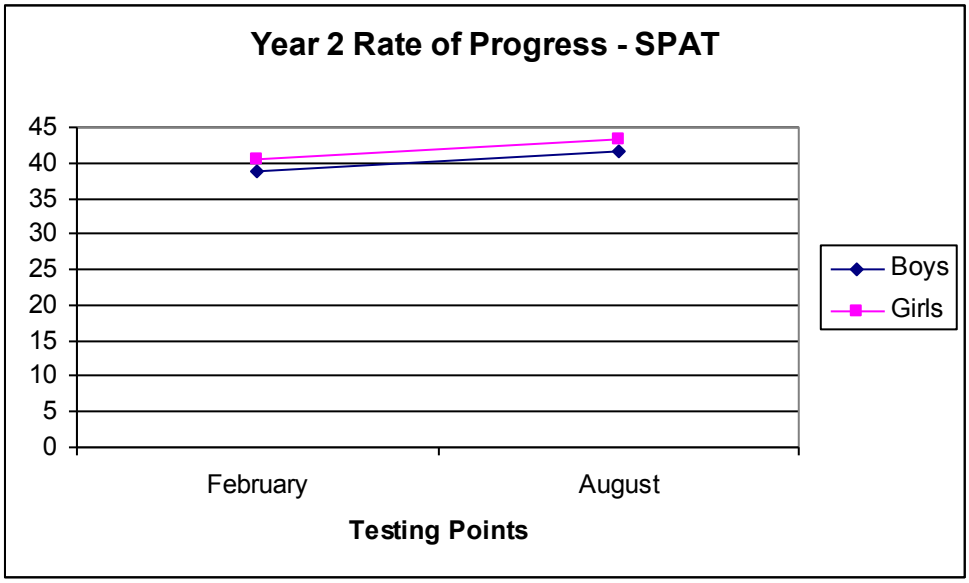

Figure 13. Rates of Progress on the SPAT for Boys and Girls in Year 2

APPENDIX 3

Appendix 3 removed from Open Access version as it may contain sensitive/confidential content.