A DYSLEXIC-TYPE PROFILE, ANXIETY AND SCHOOL-RELATED STRESS IN PRIMARY AGED STUDENTS: A NEW ZEALAND STUDY

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Abstract

The acknowledgement and identification of dyslexia are long overdue in New Zealand's education system, and there is currently little understanding of the prevalence or emotional correlates of dyslexia in Aotearoa. Research offers a range of prevalence rates (3-20%), based on various operationalised definitions. The literature also suggests that a variety of emotional difficulties often co-exist with dyslexia, yet aspects of anxiety specific to research on primary school-aged groups are underrepresented in the literature.

This study had two aims. First, this study aimed to identify the prevalence of a dyslexic-type profile (D-TP) in New Zealand for 8-10-year-old students. Secondly, this study explored the difference in anxiety and school-related stress experienced by students with a D-TP, when compared to generic poor readers and students with no significant reading difficulty. It was hypothesised that students with a D-TP will report significantly more anxiety and school-related stress than their peers.

A quantitative approach, using Nicholson and Dymock's (2015) SVR operationalised definition of dyslexia was employed with 54, 8 to 10-year-old students attending six different primary schools in the South Island of New Zealand, to establish a prevalence figure for a D-TP. Two standardised questionnaires (Spence Children's Anxiety Scale and the School Situational Survey) were administered to all participants, to gauge group differences in anxiety, across six dimensions, and school-related stress, across seven dimensions.

The results indicated an 11% prevalence rate for a D-TP, based on the SVR criteria: a figure that appears elevated in comparison to other countries; may only represent moderate to severe dyslexia, and is likely an underestimate of the prevalence of a D-TP. Questionnaire response analyses showed that the D-TP group reported significantly greater anxiety and school-related stress than their peer groups.

The study contributes towards an understanding of how the SVR-based methodology may be utilised in New Zealand for 8 to10-year-olds as an assessment for the identification of a dyslexic-type profile. It is also concluded that students with a D-TP experience greater anxiety and school-related stress than poor readers and proficient readers: a feature that not only distinguishes this group but calls for awareness in relation to their well-being.

Keywords: dyslexia, dyslexic-type profile, Simple View of Reading, anxiety, school-related stress

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Tha mi fada an comain non daoine a thainig romham
(Scottish Gaelic for, "I am grateful to the people who have come before me.")

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List of Abbreviations

BDA	British Dyslexia Association
D	Decoding
DFNZ	Dyslexia Foundation New Zealand
DSM	Diagnostic and Statistical Manual of Mental Disorders
D-TP	Dyslexic-Type Profile
LC	Linguistic comprehension
MoE	Ministry of Education
NZPsS	New Zealand Psychological Society
PAT: LC	Progressive Achievement Test: Listening Comprehension
RC	Reading Comprehension
SCAS	Spence Children's Anxiety Scale
STAR	Supplementary Test of Achievement in Reading
SSS	School Situation Survey

Statistical Abbreviations

ANOVA	Analysis of Variance
MANOVA	Multivariate Analysis of Variance

Chapter One: Introduction

The teacher requested that the children be quiet, as it was Annie's turn to read her work aloud to the class. Annie was a diligent child, who excelled in dance, enjoyed performing and gained distinction in annual speech exams. However, at this moment, her heart began to race, and she felt sick, as her cheeks flushed, and she rose from her chair. She was ten years old and knew enough to understand that she could not work out how to read the words on the page like the other children, nor could she read as quickly, or as easily as they did. Annie was diagnosed with dyslexia, by a private practitioner at eight years of age, after three years of formal schooling, having received no acknowledgement of her difficulties, nor targeted support within the school system. She was, at ten years old, acutely aware that she experienced more worry than her peers.

Unfortunately for Annie, she is enrolled in school in New Zealand, where it is suggested that dyslexia has been poorly recognised and understood among educators (Dyslexia Foundation of New Zealand, 2008; Elias, 2014), and where little policy or priority has been given to the identification of dyslexia, until very recently (Ministry of Education, 2019a). Consequently, there is no contemporary knowledge of the prevalence of dyslexia in New Zealand. Neither is there an evidence-based understanding of how it must feel to be a student with dyslexia in New Zealand. It is, therefore, the identification and prevalence of dyslexia, alongside the anxiety and stress that these students may experience that is the focus of this study.

The last fifty years of international research has culminated in a surprisingly convergent body of literature regarding the specific reading difficulties and language symptomology that accompanies dyslexia (Joshi & Aaron, 2008; Shaywitz & Shaywitz, 2003; Vellutino, Fletcher, Snowling & Scanlon, 2004). Research has also convincingly demonstrated *phonological processing,* to be the critical underlying deficit or proximal cause for the reading difficulties that have become synonymous with dyslexia (Bradley & Bryant, 1983; Pennington, 2009; Snowling, Gallagher & Frith, 2003; Snowling & Hulme, 2012; Vellutino et al., 2004). Furthermore, it is generally accepted that the nature of poor reading is somewhat *unexpected* in relation to an individual's age and

other linguistic or academic abilities (International Dyslexia Association, 2015; Vellutino et al., 2004; Wagner, 2008;).

With such a body of evidence surrounding dyslexia, it is surprising that a universally accepted operationalised definition for the identification of dyslexia remains somewhat elusive in research and practice. Progress in this particular field has been thwarted, at least in part, by differing agendas (Reid, 2016); lack of agreement on definitions and varying methodologies in research (Siegel & Lipka, 2008). Such definitional issues and the absence of agreed-upon methodology for the identification of dyslexia, have led some theorists (Elliot & Gibbs, 2008) to claim that dyslexia lacks validity as a construct. This is a view that appears prominent amongst Psychologists in New Zealand (New Zealand Psychological Society [NZPsS], 2015). This divergence from international opinion and New Zealand's historical lack of policy in relation to dyslexia makes the study of dyslexia in New Zealand particularly important.

New Zealand has lagged behind other developed countries in both its recognition and identification of dyslexia (Hawkins, 2004), with the Ministry of Education (MoE) only officially recognising dyslexia in 2007 (MoE, 2008). As such, there is currently relatively little understanding of the proportion of students in New Zealand that may have dyslexia, in comparison to other countries (USA: Katusic, Colligan, Barbaresi, Schaid & Jacobsen, 2001; UK: Stothard, Snowling & Hulme., 2013). In the absence of prevalence data, dyslexia may be underestimated or overestimated, both of which have implications for funding and resourcing. The provision of current and reliable prevalence data, in New Zealand, may also allow the beginnings of a challenge towards the disregard for the construct of dyslexia, shown by practitioners, such as those within the NZPsS (2015).

While New Zealand has taken time to acknowledge dyslexia, it is encouraging that the MoE is now demonstrating a clear commitment to making improvements in identification, via screening, and resourcing for students with dyslexia (i.e., Learning Support Action Plan [MoE], 2019). As a country with key stakeholders (i.e., Clay, 1987; NZPsS, 2015), that have historically been opposed to the classification of dyslexia, this represents a significant change. It is also a change that presents New Zealand researchers with a challenge; to develop an evidence-base for the utility and

validity of screening methods and assessment tools suitable for a New Zealand population.

To establish a reliable prevalence figure for dyslexia, a reliable methodology for identification is necessary. However, the classification of dyslexia has historically been problematic due to a lack of international consensus on how to reliably operationalise varied definitions. The *Simple View of Reading* (SVR: Gough & Tunmer, 1986; Hoover & Gough, 1990), and the methodology proposed by Nicholson and Dymock (2015) offer a solution to the preliminary identification of dyslexia in New Zealand. The Simple View of Reading is a framework that has been recommended and utilised for identification of dyslexia in educational policy elsewhere (e.g., in England: Department for Educational Services, 2006; Rose, 2009) and recommended for preliminary assessment of dyslexia in the New Zealand school context (Nicholson & Dymock, 2015). The SVR provides a conceptual framework that accounts for typical and atypical reading performance based on two components: word-level decoding and linguistic comprehension while enabling the preliminary identification of dyslexia, based on the assessment and identification of symptoms manifesting in reading. By combining the dominant hypothesis of a phonological processing deficit (i.e., low word-level decoding) with a discrepancy in comprehension (i.e., high listening comprehension and low reading comprehension), the SVR operationalises the 'unexpected' nature of dyslexia.

Nosological debates aside, common sense would suggest that individuals who struggle to master essential reading skills, may be vulnerable to additional emotional difficulties, especially within the school context. There is a growing body of international literature that relates to the negative emotional correlates of dyslexia, in relation to self-esteem (Burden, 2008; Humphrey, 2002); depression (Alexander-Passe, 2006, 2012) and stress (Alexander-Passe, 2008; Miles, 2004). Research suggests that an association may exist between dyslexia and anxiety (Davis, Margolis, Thomas, Huo, & Marsh, 2017; Mammarella et al., 2016; Mugnaini, Lassi, La Malfa & Albertini, 2009; Nelson & Harwood, 2011; Novita, 2016; Willcutt et al., 2013). However, many studies have focussed on *general* anxiety and dyslexia in adolescents or students in further education. Little is known about which dimensions of anxiety are most prevalent in

students with dyslexia, and only one study has been identified to examine which aspects of school are stressful for this group (Alexander-Passe, 2008).

Given the somewhat belated acknowledgement of dyslexia in New Zealand, there is a paucity of studies examining anxiety and school-related stress in primary school student with dyslexia. Furthermore, while there is a growing body of literature that recognises the importance of the identification of dyslexia for reducing the risk of associated emotional, behavioural difficulties (Burden, 2005; Eissa, 2010; Törő et al., 2018), dyslexia screening is not yet in place in New Zealand schools. It is, therefore, timely to investigate the potential anxiety that students with dyslexia may experience in the New Zealand primary school context. This focus is also seen as politically relevant given New Zealand's current government's desire to have an education system where well-being is "safeguarded and promoted" (Learning Support Action Plan, MoE, 2019. p.4).

The Present Study

This study had two primary objectives. First, the study aimed to establish the prevalence of a dyslexic-type profile in 8-10-year-old students. For this study, the term '*dyslexic-type profile (D-TP)*' was adopted to acknowledge that the chosen methodology is non-diagnostic. Participants in this group have not been provided with a formal diagnosis by the researcher. Instead, a dyslexic-type profile was identified by adapting a protocol devised by Nicholson and Dymock (2015), to be used as a preliminary screening procedure for dyslexia in the New Zealand classroom. Secondly, the study aimed to investigate whether students with this dyslexic-type profile experience higher levels of anxiety in specific domains, or more considerable school-related stress, in comparison to their peers. This dual-purpose should be viewed in the context of New Zealand, where consensus is lacking, not only in an operationalised definition of dyslexia for identification purposes but with regards to the acceptance and definition of dyslexia.

It was hoped that this study might broaden classroom teachers' understanding of preliminary assessments that can be used within the classroom, using tools that are already at their disposal, to identify students with a dyslexic-type profile. Additionally, if there was an association found between a dyslexic-type profile and emotional distress

in children of this age, it was hoped that awareness would grow in relation to students with a D-TP being at-risk for elevated anxiety or stress.

The four main research questions were:

1. What is the prevalence of a dyslexic-type profile in an eight to ten-year-old cohort of primary school students in New Zealand?

2. *Do children with a dyslexic-type profile experience greater anxiety than their peers?*

3. *Do children with a dyslexic-type profile experience greater school-related sources of stress that their peers?*

4. *Do children with a dyslexic-type profile experience greater school-related manifestations of stress that their peers?*

Personal Perspective and Professional Experience

The researcher's reasons for choosing this project are both personal and professional. Kirby (2018) describes the 'hidden history' of pioneering women researchers in dyslexia being mothers of children with dyslexia. This researcher understands how emotive and motivating a force it can be to witness your child's experience of dyslexia. Specifically, the researcher has experienced first-hand, the 'wait-to-fail' approach to the identification of dyslexia for her child and the increasing anxiety that her child has experienced as she travelled through school. However, this project was initially conceived during the researcher's time working as a special needs coordinator in a New Zealand school. The researcher experienced many articulate students, who were identified as reading below their chronological age, despite expectations from teachers and parents that they ought to be reading well. They displayed average, or above-average oral language skill, and came from homes where lots of reading occurred and was encouraged. However, classroom reading programmes and 1:1 reading recovery appeared to do little to reduce the gap in reading for some of these students. In addition, they appeared more frustrated and often more anxious than their peers, some of whom were also reading below their chronological age. As a UK-trained primary teacher, the researcher was surprised to learn (in her initial employment in a New Zealand classroom) that students may only receive a diagnosis of dyslexia in New Zealand if they were able to fund a private psychological assessment. In the

absence of the provision for state-funded identification, the researcher then became interested in the possibility of identifying a D-TP within the classroom. She also wished to examine whether or not students with this profile, which had potentially gone unrecognised in New Zealand, experienced more anxiety and stress in comparison to their peers.

Thesis Overview

This thesis is comprised of five further chapters. The second chapter reviews the literature that is the foundation for this study, including the history, aetiology and prominent hypotheses regarding dyslexia; a critique of identification methods and prevalence studies; the componential model of reading as a theoretical framework and the *Simple View of Reading* as a pragmatic framework to understand and identify students who demonstrate dyslexic type difficulties in their reading. The literature review then examines anxiety and stress, corresponding theory and international research examining these emotions independently and as correlates of dyslexia. The third chapter is concerned with the methodology used for this study, including a description of the research design; quantitative methods; ethical considerations; instruments; procedures and data analysis involved in the study. The fourth chapter presents the findings of the research, with regards to the four research questions. The fifth chapter discusses the findings with respect to the existing literature. The final chapter outlines the contributions this study has made to New Zealand research; implications in relation to the identified prevalence figure and emotional-correlates; considerations for future research and recommendations arising from this study.

Key Terms and Definitions

Anxiety: In this study, anxiety is defined as feelings of worry in relation to domains of anxiety, aligned to the DSM-V subgroups and their unique symptoms, rather than anxiety disorders per se.

Decoding: The skill of word recognition, specifically: the skill of applying orthographic-phonological (text-sound) knowledge to pronounce written words (Gough and Tunmer, 1986).

Dyslexic-type profile: The term '*dyslexic-type profile*' has been adopted to acknowledge the method as non-diagnostic. However, the term *dyslexia* or *dyslexic* will be used throughout this study when drawing on literature.

Generic poor reader: Describes students who meet criteria for both poor listening comprehension and poor reading comprehension, as outlined by the SVR, with New Zealand-specific criteria (Nicholson & Dymock, 2015).

Internalising: Behaviour that involves withdrawal, loneliness or sadness, and includes anxiety, depression, suicidal ideation and physiological/somatic complaints (Achenbach & Rescorla, 2001).

Listening comprehension: The ability to derive meaning from spoken language or written language, when read aloud; also referred to as *linguistic comprehension*.

Phonology: The system of sounds within a language (e.g., phonemes, onsets, rimes, and syllables).

Progressive Achievement Test: Listening Comprehension (PAT: LC): A New Zealand developed, standardised assessment tool, designed to assess listening comprehension.

Reading Comprehension: a complex interactive process where written text is processed to provide meaning.

Stress: In this study, 'stress' refers to feelings in relation to expectations or requirements that exceed the resources the individual is able to bring to the task (Lazarus, 1999).

Supplementary Test of Achievement in Reading (STAR): A New Zealand developed standardised assessment tool, designed to assess student progress and achievement in reading

<center>**Chapter Two: Review of Literature**</center>

This chapter begins with a brief history and synopsis of the aetiological understanding of dyslexia, followed by an exploration of current international and national definitions. It is argued that while there is some consensus on conceptual definitions, there is consistent divergence when attempts are made to operationalise these definitions, which often leads to invalid and unreliable methods of classification or, at worst, denial of the construct itself. The *Simple View of Reading* (Hoover & Gough, 1986) is introduced, as a model that could be operationalised within New Zealand classrooms, for the preliminary identification of students with dyslexia (Nicholson and Dymock, 2015). International and National prevalence estimates for dyslexia are explored. Subsequently, the existing literature is examined relating to anxiety and stress, as well as anxiety and stress co-existing with dyslexia. Finally, the aims of this research study and research questions are presented in the context of gaps in the existing literature within New Zealand and beyond.

Understanding Dyslexia

A brief history and aetiology of dyslexia. Developmental dyslexia, first construed as a visual disorder, was initially recorded in 1896, by Pringle-Morgan, an Ophthalmologist, who reported observations of a boy who could not read despite demonstrating above-average intelligence (Guardiola, 2001). Since then, significant leaps in understanding of dyslexia have occurred, as research moved from Opthalmology into the domain of cognitive psychology, revealing a convincing cognitive phenotype (Pennington, 2009). To understand and communicate the nature of dyslexia, researchers, teachers and other practitioners require a definition that is both reliable and valid (Elliot & Grigorenko, 2014; Waesche, Schatschneider, Maner, Ahmed, Wagner, 2011). However, the search for such a definition is problematic, as the definition itself cannot be separated from proximal and distal aetiological understanding, neither of which seem to suffice in isolation. The following section introduces evidence from various fields of research that have contributed to an aetiological perspective based on the proximal cause of dyslexia. Much of this focus begins with the *phonological deficit hypothesis*.

A phonological deficit. The phonological deficit hypothesis suggests that the proximal cause of the reading difficulties that are synonymous with dyslexia is a language processing deficit at the phonological (i.e., speech sounds), level (Bradley and Bryant, 1978; Hulme & Snowling, 2013; Snowling, Gallagher & Frith, 2003). The evidence supporting this language-based hypothesis will now be outlined.

At the behavioural level, poor reading and decoding skills (i.e., key symptoms of dyslexia) are central to investigation and theory. However, as with most abilities, there is a continuum in phonemic awareness, whereby all individuals do not grasp the alphabetic principle (and associated representations) with equal ease (Shankweiler & Fowler, 2004). Some students will experience difficulties with word recognition, characterised as a deficiency in phonological skills (Catts & Kamhi, 2005; Vellutino & Fletcher, 2007). According to the phonological deficit theory, this deficiency is proposed to be the core deficit-characteristic of dyslexia, despite this deficit being present in virtually all poor readers (Stanovich & Siegel, 1994; Stuebing et al., 2002; Tunmer & Greaney, 2010). Therefore, while it should be clear that this hypothesis is not sufficient to operationalise a definition of dyslexia, the evidence in relation to this key core-deficit still deserves attention.

Cognitive theories attempt to draw out the underlying reasons for the behavioural symptoms. Phonological processing is a core pre-requisite skill in proficient reading (Peterson and Pennington, 2012; Snowling, 2001; Vellutino et al., 2004) and in the words of Perfetti (2011), "the idea that reading words requires phonology has ascended from a minority view to one with such a substantial majority that it now amounts to conventional wisdom." The manifesting difficulties that have been demonstrated include; poor representations (Griffith & Snowling, 2002; Snowling 1981), the storing, retrieving and processing of representations within working memory (Brady, Shankweiler & Mann, 1983, Torgesen, Wagner, Rashotte, Burgess & Hecht, 1997). While phonological processing skills have been shown to be correlated directly with decoding at the word level (Willcutt et al., 2013), weak phonological coding of the multiple layers of speech sounds, including phonemes, onsets, rimes and syllables, have all been implicated in this theory (Hulme & Snowling, 2013, Rose, 2006). Pennington (2009) argues that cognitive theorists have made evident that dyslexia is a disorder of

language, rather than ocular pathology, and that under-developed and insufficient phonological representations are the neuropsychological deficits at play.

Biological theories implicate divergent genetic and neural pathways for dyslexia, with neuroimaging research supporting the importance of phonological-processing for proficient reading and the phonological-deficit hypothesis. The reliance on phonological processing for reading is demonstrated by researchers (McCory, Mechelli, Frith & Price, 2004), who identified the same physiological brain systems to be activated when reading and processing phonological information. Pennington and Olson (2005) add to this body of work by demonstrating that reading comprehension and phonological skills share significant genetic variance. Specifically, for dyslexia, the phonological-deficit hypothesis is supported by evidence of structural and functional anomalies in the dyslexic brain, identified through neuroimaging and intervention studies. Researchers have shown that when a dyslexic student is engaged in phonological processing, there is reduced or negligible activity in the left hemisphere temporoparietal cortex, parieto-temporal, and occipito-temporal regions; a marked difference to activity seen with typical readers (Hoeft et al., 2006; Maisog, Einbinder, Flowers, Turkltaub, & Eden, 2008; Paulesu et al., 1996; Rumsey et al., 1992). Furthermore, the divergent circuitry observed in neuroimaging of older dyslexic brains is seen in typically developing much younger pre-schooler brains (Simos et al., 2002), indicating the immature, or deficit-nature of neural processing of phonological information within the dyslexic brain. There is also evidence from intervention studies demonstrating, phonological skills training to be a successful intervention for dyslexia (Duff, Hayiou-Thomas & Hulme, 2012; Snowling & Hulme, 2012; Vellutino et al., 2004), and post-intervention brain imaging showing greater left-brain activation similar to typical readers (Shaywitz & Shaywitz, 2003). Hulme and Snowling (2013) encourage the reader to consider the behavioural, cognitive and biological levels of explanation as not opposed to each other, but acting simultaneously with the environment, to produce the observable deficits in dyslexia.

Critics of the phonological deficit theory point out that it is more tautology than theory (e.g., Stein, 2018), and that correlational studies cannot reveal causality (Castle and Coltheart, 2004). However, while the combined evidence for a phonological deficit does not offer a distal cause, the volume of research offers evidence for a language-

based profile of a dyslexic student with a convincing proximal cause. Further criticism has arisen following the identification of dyslexic readers who do not have a phonological deficit (Ramus et al., 2003; White et al., 2006); a finding that encouraged Snowling (2008) to propose an endophenotype hypothesis, whereby a phonological processing deficit may be independent of dyslexia, and may sit between the genotype and the gene's expression (i.e., the phenotype). This concept fits well with the work of Van Bergen, De Jong, Plakas, Maasen and Van Der Leij (2012), who demonstrated some children in their sample, with a familial risk of dyslexia and reading skills in the average range, still show signs of a phonological deficit. Additional criticism of the phonological-deficit hypothesis includes there being no accounting for elements such as sensory processing, and other essential reading skills such as language comprehension (Stanovich, 1994; Stein, 2018). Nevertheless, the empirical work in this field has been invaluable in signposting a proximal cause (i.e., a phonological processing deficit) for the reading difficulties associated with dyslexia. However, because this deficit is shared with virtually all poor readers, a phonological processing deficit could be considered necessary, but not sufficient criteria, when attempting to define or identify dyslexia.

Alternative deficit hypotheses. Research has also searched for the underlying distal causes for dyslexia. Theories suggesting difficulties in the visual processing system, such as Orton's (1925) optical reversibility theory, and Herman's (1959) spatial confusion theory, were popular up until the 1980s. These theories remain unsubstantiated by empirical evidence (Vellutino & Fletcher, 2007) and later became overwhelmed by theories of linguistic deficit (Snowling, 2001; Vellutino et al., 2004). However, some empirical support arose, suggesting a deficit in the magnocellular system; a system that inputs visual information to the cerebellum and controls eye movements and visual attention (Livingstone, Rosen, Drislane & Galaburda, 1991; Lovegrove, Bowling, Badcock & Blackwood, 1980). Specifically, the magnocellular deficit is suggested to produce a longer than usual visual trace, which masks text during connected text reading. However, the magnocellular deficit theory does not account for the consistent difficulty that children with dyslexia encounter when reading single words (Vellutino et al., 2004) and the contribution of variance from phonological processing skills to predict poor reading skills far outweighs the variance attributed to visual processing deficits (Eden, Stein, Wood & Wood, 1995), making causality implications problematic. There is some evidence to suggest that a key deficit in

dyslexia is a weakness in temporal processing, which impedes the ability to sequence the order of sounds in spoken words and the letters in written words (Stein, 1993). Additionally, researchers argue that a phonological deficit may arise from a lack of 'literate cultural capital', i.e., literacy-related knowledge gained from the preschool/home environment (Tunmer & Chapman, 2006; Tunmer & Nicholson, 2011). Drawing on Hulme and Snowling's (2013) proposition of interacting levels, it is likely that both distal and proximal factors do not operate in isolation.

Some researchers have argued that dyslexia occurs as a result of multiple deficits, rather than singular causality (Frith, 2002; Pennington, 2006; Pennington et al., 2012). Pennington et al., (2012) applied and compared individual theoretical approaches to identifying dyslexia to a sample of 83 dyslexic students. Their study showed that not one of the existing models fully accounts for dyslexia: the phonological deficit accounted for 11 cases, and the multiple method deficit accounted for 18 individuals. However, a similar longitudinal study, examining pre-reading skills of children, indicated that the phonological deficit would account for dyslexia (Carroll, Solity & Shapiro, 2016). The age range in Pennington et al.'s, (2012) study (8-18-years-of-age) was much broader than that of Carroll et al., (2016). Further studies would perhaps reveal differences in the predictability of models across age groups. The proponents of a multiple deficit theory appear to have helped redirect research from singular causality towards an examination of multiple distal and proximal risk factors.

To conclude the aetiological summary, it is useful to consider the three-level causal framework proposed by Frith (2002), which allows us to conceptualise dyslexia, as multiple deficits that act as risk factors, which interact with environmental factors, to encourage or ameliorate the symptoms of dyslexia. First, the biological level, where neurodevelopmental and genetic aspects manifest in physiological brain differences. Second, the cognitive level, which acknowledges the disruption in phonological and, or visual and, or temporal processing mechanisms. Thirdly, where behavioural and environmental influences, such as parents, instruction and the individuals' emotional state interact (Helland, 2007). However, while Frith's (2002) broad conceptual model provides us with a relevant framework to understand the aetiology of dyslexia, her model does not offer, neither purport to offer, enough specificity to allow for reliable and valid definition, assessment and identification of dyslexia.

The search for a definition The Diagnostic and Statistical Manual of Mental Disorders (5th edition.; DSM-V; American Psychiatric Association [APA], 2013), defines Dyslexia under the umbrella term *Specific Learning Disorder* (SLD) with impairment in reading; describing dyslexia as a neurodevelopmental disorder causing deficits in academic skills related to reading, including reading rate/fluency, single-word reading accuracy and reading comprehension (Appendix A). A second prominent diagnostic manual (the International Classification of Diseases (ICD-II) differs somewhat in definition, categorizing dyslexia as a *Developmental learning disorder* (World Health Organisation: WHO, 2019), but diverges from the DSM-V in alluding to an intelligence-achievement discrepancy (Appendix A).

International approaches to defining dyslexia. In order to examine the heterogeneity of definitions more closely, definitions from key governing bodies, organisations and government education departments were examined, and the results are far from homogenous (Appendix A; Table 1). There is general consensus across definitions that literacy and word-reading deficit should be central in a definition (Table 1; Appendix A). However, there is lack of consensus in the inclusion of additional deficit-criteria (e.g., phonological awareness/processing, numeracy problems and working memory difficulties), which makes operationalising a definition challenging. A definition for dyslexia requires attention to many complicated phenomena, which function at different levels and definitions vary in what they include, exclude and emphasise. Nevertheless, when examining the heterogeneity of definition, it is vital to consider the author's audience and purpose; the reliability and validity of the definition, as well as the capacity for the definition, to be operationalised.

The purpose of a definition. The variable hidden agendas within definitions are central to how researchers, teachers, parents or psychologists judge the validity and reliability of a definition and indeed, the construct itself. Agendas identified within the literature can be categorised into three groups. First, a definition may increase awareness, by providing educators, children and family an explanation regarding a child's lack of progress or response to instruction (Reid, 2016)(e.g., advocacy groups such as Dyslexia Foundation New Zealand [DFNZ] and the International Dyslexia Association [IDA]). Second, a definition may provide a label to meet eligibility criteria

Table 1. Criteria included in definitions from relevant international organisations and bodies

Group/Organisation	Deficit criteria											Inclusion Criteria	
	literacy	reading	numeracy	writing	achievement discrepancy	phonological	auditory	visual	cut-off points	processing speed	memory	adequate instruction	above average listening comprehension
International Classification of Diseases (2017)	n	y	n	n	y	n	ex	ex	n	n	n	n	n
International Dyslexia Association (2015)	y	y	n	y	y	y	ex	ex	n	n	n	y	n
American Psychiatric Association (2013)	n	y	n	n	n	n	n	n	y	y	n	n	n
Ministry of Education, New Zealand (2008)	y	y	y	y	n	y	n	n	n	n	n	y	n
The Scottish Executive (2009)	y	y	n	y	y	n	n	n	n	n	n	y	n
Dyslexia Foundation (New Zealand) (2006)	y	n	y	n	n	n	n	n	n	n	n	n	n
British Psychological Society (1999)	y	y	n	n	n	n	n	n	n	n	n	n	n
British Dyslexia Association (2014)	y	n	n	n	y	y	n	n	n	n	y	y	n
Total N to mention criteria	6	6	2	3	4	3	0	0	1	1	1	4	0

y = mentioned in the definition as a criteria; n = not mentioned in the definition as a criteria; ex= mentioned as exclusion criteria

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for funding (Tannock, 2013). In the UK, for example, a dyslexia label will allow access to a reader resource for examination (Armstrong & Squires, 2015). Equally, in high school in New Zealand, *special assessment conditions* such as extra time or a reader-writer in examinations, depend on a *Specific Learning Disorder* diagnosis with associated criteria (New Zealand Qualifications Authority, 2019). Finally, the scientific agenda often requires the operationalisation of a conceptual definition; agreement on which symptoms (reflecting the conceptual definition) are to be measured and how they are to be measured (Stanovich, 1991; Siegel and Lipka, 2008).

The New Zealand context. New Zealand has historically demonstrated a substantial divergence from international acceptance and definition of dyslexia (Hawkins, 2004). New Zealand's Ministry of Education (MoE) only recognised dyslexia in 2007, over 100 years after Pringle-Morton recorded his first observations. Additionally, there is a lack of consensus nationally, with regards to definition (e.g., between the NZPsS, the DFNZ and the MoE). For instance, the NZPsS, unlike the British Psychological Society (BPS), does not define, nor appear to accept the construct of dyslexia. Their submission to the Parliamentary Education and Science committee in 2015, expressed an opinion that "Dyslexia is no longer a useful diagnosis to discriminate a group of students from other poor readers", and, "There is no convincing evidence that dyslexia can be reliably diagnosed, so as to distinguish this group." (NZPsS, 2015, p.5). While the DFNZ (2006), a New Zealand-based advocacy group, does offer a definition, there is again, a lack of specificity to enable their definition to be operationalised (see Appendix A).

The New Zealand literature reveals two reasons for this divergence; an active whole language approach to literacy instruction (Chapman, 1992; Chapman, Tunmer & Allen, 2003; Tunmer & Chapman, 2006) and a non-categorical needs-based approach to learning support (Tumner & Greaney, 2010). Briefly, the *whole language* approach to reading instruction emphasises sentence-level context cues rather than grapho-phonic information to identify words. This approach represents one polarised position in the 'reading wars', where a phonological approach to reading instruction is at the other end (Ewing, 2006; Tunmer & Chapman, 2015). The historical opposition to labelling students as 'dyslexic' came from influential proponents (e.g., Clay, 1987) of the whole language pedagogical approach to literacy instruction in New Zealand (Tunmer &

Chapman, 2006), and from a learning support system with a needs-based, rather than category-dependent, approach to provision.

One year following the official recognition of dyslexia, New Zealand gained the following definition, albeit a working definition, within education:

"A spectrum of specific learning difficulties (that) is evident when accurate and, or fluent word reading and writing skills, particularly phonological awareness, develop incompletely or with great difficulty. This may include difficulties with one or more of reading, writing, spelling, numeracy or musical notation. These difficulties are persistent despite access to learning opportunities that are effective and appropriate for most other children." (MoE, 2008).

This working definition has received criticism from NZ researchers, Tunmer and Greaney (2010), regarding the lack of reference to phonological recoding or processing skills, as the specific deficit. While the definition lacks specificity in behavioural symptomology, the MoE should be acknowledged for its reference to a phonological-deficit. This deficit is not emphasised or included in other national education service definitions (e.g., The Scottish Executive, 2009), nor all identified definitions (see Table 1). Nevertheless, the demands for specificity seem appropriate, given that New Zealand's education system and educators within this system are currently developing an understanding of dyslexia and how to identify those students who may be affected (DFNZ, 2008; Elias, 2014).

Identification and Classification of Dyslexia

Three key conceptual models emerge from the literature which attempt to support the identification of dyslexia; the *IQ-Achievement Discrepancy* model, the *Response to Intervention* model and the *Componential Model*. In this section, the lack of empirical evidence supporting the IQ-Achievement Discrepancy method (IQ-ADM) will be summarised. The Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) will be introduced as an alternative means to identify dyslexia, nestled within the more comprehensive Componential Model of reading disability (Joshi & Aaron, 2008). The Response to Intervention approach will be outlined, highlighting promise in countries utilising evidence-based reading instruction approaches. The

Simple View of Reading is then presented as the most relevant approach to identify students with a dyslexic-type profile, in the current context of New Zealand's persistent whole-language approach to instruction.

The rejection of the IQ-achievement discrepancy approach. Until recently, the IQ-ADM was the predominant method utilised to identify dyslexia, in practice and research (Restori, Katz & Lee, 2009) and was generally utilised to operationalise the *unexpected* nature of poor performance in reading. Indeed, three out of eight dyslexia definitions in the literature (Appendix A), refer to the *unexpected* nature of poor reading. The IQ-ADM operationalised this unexpected underachievement as an aptitude-achievement discrepancy, whereby dyslexic readers were distinguished from generic poor readers based on having a high-IQ (i.e., an unexpected discrepant finding in relation to their poor reading ability). The reverse assumption of the IQ-ADM is that generic poor reading was *expected* based on low cognitive ability. However, this approach has been largely rejected by the research community (Fletcher et al., 2002; Vellutino et al., 2004).

The validity and reliability issues of the IQ-ADM are well documented (Fletcher et al., 2002, Restori et al., 2009; Steubing et al., 2002; Vellutino, Scanlon & Reid-Lyon, 2000). Many researchers (Carroll et al., 2016; Fletcher et al., 2002; Fletcher et al., 2006; Vellutino et al., 2004) have established that the IQ-ADM fails to correctly identify discrepant low achievers from non-discrepant low achievers in a meaningful way. First, it has been demonstrated that IQ assessments are invalid as measures of intelligence for dyslexic students, who may naturally underperform in IQ tests (Siegel, 1989, 1992; Swanson, 1994). Second, IQ scores do not appear to be significant predictors of the distinctive underlying cognitive skills involved in reading, therefore reducing the validity of the IQ-ADM (Shaywitz & Shaywitz, 2003; Shaywitz et al., 1992, Stanovich and Siegel, 1994, Stuebing et al., 2002). It appears that the IQ-ADM represents and identifies the operational definition of unexpected underachievement, based on a population that performs well in IQ tests, rather than dyslexia per se. A final threat to the validity of this method is the inability of the IQ-ADM to suggest appropriate intervention (Fletcher et al., 2006; Lyon & Fletcher, 2001; Schneider & Kaufman, 2017; Shaywitz & Shaywitz, 2003). However, not all researchers reject the IQ-AD definition.

Some proponents of the IQ-ADM suggest that the method is important for the validity of construct (Kavale, 2002; Mastropieri & Scruggs, 2002) and social justice (Colker, 2013; Stanovich & Stanovich, 1997). The latter researchers argue that dropping the IQ-ADM methodology denies this group recognition of *potential*. Unrecognised *potential* in a group of children is undoubtedly a social justice issue; yet, the IQ-ADM offers no guidelines regarding how to intervene to remediate this injustice. Mastropieri and Scruggs, (2002) claim that the IQ-ADM preserves the *unexpected* aspect of dyslexia. However, new models for identifying dyslexia emerged in the 1990s, that classified students with a dyslexic-profile based on proximal cause and other discrepancies with more validity. One such discrepancy approach preserved the concept of *unexpected difficulties* by replacing IQ scores with listening comprehension scores (Aaron 1991; Stanovich, 1991); forming the basis of one component of the Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990).

The *Simple View of Reading*: an alternate model for identifying a dyslexic-type profile. The Componential Model of Reading (Joshi & Aaron, 2008), goes beyond the broad conceptual model proposed by Frith (2002), by adding specificity for identification and definition of independent processes that can influence reading skill development within three domains; the cognitive, psychological and ecological domain (Figure 1).
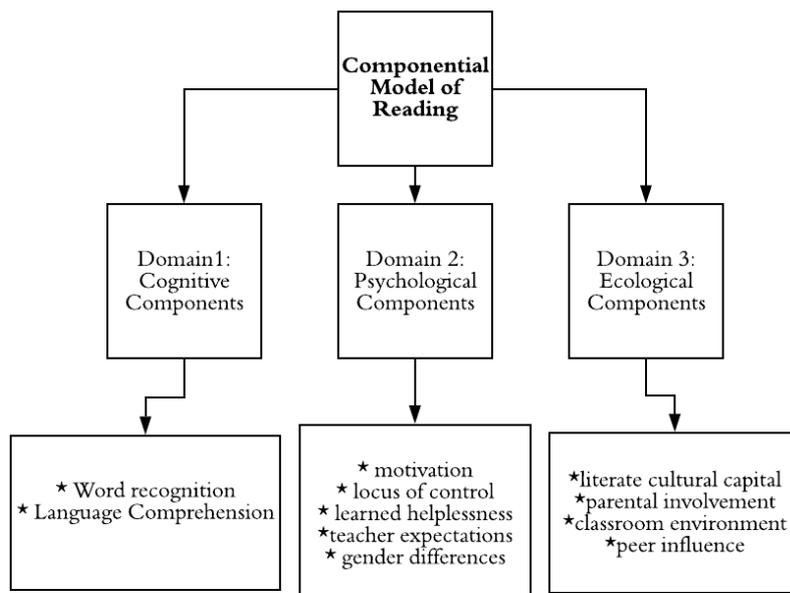
Figure 1. The Componential Model of Reading. From Assessment of Literacy Performance based on the Componential Model of Reading", by G Aaron, P. Joshi, R. Gooden and K. Bentum in (Reid, Fawcett, Manis & Siegel), The Sage handbook of Dyslexia (2008, p.272).

Joshi and Aaron (2008) developed the cognitive domain of their model around the Simple View of Reading (SVR) proposed by Gough and Tunmer (1986), who argued that the prerequisite cognitive components of reading are distributed across two components: decoding (D) and language comprehension (LC). The SVR represents a model of reading comprehension that does not purport to identify the etiological typology of dyslexia. Rather, the SVR identifies the proximal and necessary broad skills required for proficient reading that are often deficient in readers with specific reading difficulties. Hoover and Gough (1990) defined decoding (D) as efficient word recognition. Language comprehension (LC), synonymous with linguistic comprehension or listening comprehension, is described as, " the process by which given lexical information, sentences and discourses are interpreted" (Gough & Tunmer, 1986, p.7). Whereas, the primary objective of reading is to draw meaning from written text: Reading comprehension (RC). This dual-componential aspects of RC arose from Gough and Tunmer's SVR, whereby they proposed that RC is the product of word recognition (D) and linguistic comprehension (LC):

$$RC = D \times LC$$

If D = 0 or LC = 0; RC will also be 0. In essence, both D and LC are believed to be prerequisites for proficient reading, yet insufficient in isolation.

Supporting evidence for the SVR comes from research using latent variable methods (Adolf, Catts & Little, 2006; Foorman, Herrera, Petscher, Mitchell & Truckenmiller, 2015), that has demonstrated most of the variance in RC can be explained by the two components; both of which contribute independent variance to RC (Aaron, Joshi, Gooden & Bentum, 2008; Tunmer & Hoover, 1992). It has been discussed that difficulty in decoding single words is a key symptom of dyslexia that manifests while reading and this deficit should be viewed within a framework that accounts for how typical and atypical reading comprehension occurs (Elliot & Grigorenko, 2014). The SVR offers a suitable framework (Figure 2), whereby typical readers (good RC) and students with heterogeneous reading difficulties can be identified from weakness in D and, or LC. Students with adequate LC and D are considered to be

typical readers, whereas those with weak word decoding (D) are suggested to be dyslexic:

	Poor language comprehension(LC)	Good language comprehension(LC)
Good decoding(D)	Poor RC. **Specific Reading Comprehension Difficulties**	Good RC. **No reading difficulty**
Poor decoding(D)	Poor RC. **Mixed Reading Disability**	Poor RC. **Dyslexia**

Figure 2. The Simple View of Reading.

The appeal of this model is two-fold. First, the model anticipates readers to be distributed according to their relative strengths and weakness across the two components, rather than categorized (Catts, Adolf & Weismer, 2006), according to one component. The phonological-deficit hypothesis attempts to categorise dyslexia based on one deficit. By incorporating above-average listening comprehension the model goes beyond the phonological-deficit hypothesis, to differentiate dyslexic readers from generic poor readers, by accounting for the 'unexpected' nature of poor reading that is not necessarily present in generic poor readers. Second, this model is inclusionary when identifying dyslexia (i.e., does not exclude based on factors such as intelligence).

For this study, the SVR was used to identify three groups of students for comparison: students with a *dyslexic-type profile* (those readers with poor RC; poor D, and good LC); generic poor readers (with either mixed or specific comprehension difficulties: poor RC and poor LC) ; and students with no identified reading difficulties.

The Response to Intervention model. An alternative approach to screening for dyslexia can be found in the Response to Intervention (RTI) model (Fuchs & Fuchs, 2006), which has a developing evidence-base as a framework for the identification of dyslexia (Fletcher & Reynolds, 2010; Preston, Wood & Stecker; 2016; Torgesen, 2009. Started in the USA, RTI proposes that children with dyslexia can be identified as non-responders by monitoring their progress in a tiered approach to instruction. Within this approach, Tier 1 is preventative and involves evidence-based explicit, purposeful instruction (Vaughn and Fuchs, 2006), including text-based and phonological code-based approaches to building essential skills in decoding and recoding, required for

word-recognition (Vellutino, Scanlon, Small & Fanuele, 2007). Tier 1 should effectively eliminate inadequate instruction as a causal factor in dyslexic-type reading difficulties, by the use of differentiated instruction in phonics, linking phonemic awareness to letter and word recognition (Ehri, Nunes, Willows, & Schuster, 2001; Kamhi & Catts, 2017). The RTI framework has received criticism for being deficient in explicit detail on research-based and accessible screening and assessment methodology (Berkeley, Bender, Peaster & Saunders, 2009; Fuchs & Fuchs, 2016). Therefore, the RTI approach is best-viewed as a framework within which the SVR could operate. In a context which encourages the use of evidence-based reading instruction, the SVR model could permeate all three levels; with screening at tier one and targeted small group intervention at tier two, to address underlying area of weakness, whether it be decoding skills (Lovett et al., 2000; Torgeson et al., 2001) or language comprehension (Swanson & Deschler, 2003), or both.

Dyslexic-Type Profile: a Definition for this Study.

For this study, a dyslexic-type profile is obtained by operationalising the Simple View of Reading, which is inclusive of empirically-identified proximal and measurable deficits. A D-TP will also be defined by the child being, "otherwise typically developing", as proposed by Tunmer and Greaney (2010, p.239), by the use of exclusion criteria, in relation to the participants' typical development, as outlined in the methodology chapter. Specifically, for the purposes of this study, the definition of a dyslexic-type profile can be viewed in terms of the following three components: (a) a discrepancy in language comprehension ability; with below-average ability in reading comprehension and above-average ability in listening comprehension; (b) in children that are otherwise typically developing; (c) who display a deficit in phonological processing, as demonstrated by a below-average word-level decoding ability.

Prevalence of Dyslexia

This section reviews the available prevalence estimates for dyslexia. According to international estimates, approximately 3-20% of children have dyslexia (Katusic et al., 2001; Stothard, Snowling & Hulme, 2013; World Health Organisation, 2019); a figure that represents between one and six children in the average (20-30 student) classroom. Lower estimates of the prevalence in children range from 3 to 10%

(Shaywitz, Shaywitz, Fletcher & Escobar, 1990; Maughan & Carroll, 2006; Miles, 2004; Shaywitz & Shaywitz, 2003, 2005). Whereas other studies have suggested higher estimates of up to 20% (Rutter et al., 2004; Shaywitz, Fletcher & Shaywitz, 1994). The variability in prevalence rates has been attributed to cut-off points, definitions and the difference in clinical and random population samples (Rose, 2009). However, given the lack of coherent international consensus on a definition of dyslexia, it is unsurprising that prevalence estimates vary substantially, as do measures, methods and criteria utilised to identify dyslexia. Ultimately, prevalence estimates should be viewed as specific to a particular sample and the way in which the researchers have chosen to operationalise their definition, for the purposes of their study.

National and international advocacy groups vary in their published prevalence estimates for dyslexia. The International Dyslexia Association, for example, estimates a 15 – 20% prevalence figure (IDA, n.d), whereas the Dyslexia Foundation for New Zealand (DFNZ, n.d.) and British Dyslexia Association (BDA, n.d.) propose a figure of 10%; a figure that has risen from 4%, for the BDA (2002). There is no clarity on the source of data for the DFNZ, IDA or BDA figures. It is therefore imperative to look towards non-selected epidemiological studies (Table 2), to elucidate prevalence figures, as these studies also negate the effects of sample and ascertainment bias that can arise from small, or clinic-drawn samples.

Establishing a prevalence figure for dyslexia is problematic. Reading skills are continuous in nature, as is the severity of skill-deficit associated with reading, in dyslexia. Therefore, a cut-off point for classification is arguably an arbitrary exercise (American Psychiatric Association, 2013; Snowling, 2013), as degrees of deficit will sit on either side. However, a cut-off point is often required for eligibility and scientific agenda. The DSM-V (APA, 2013) definition utilising a cut-off for achievement scores on a standardised test of reading at 1.5 standard deviations (SDs) below the mean for age (i.e., 7% of the population). However, prevalence estimates will increase as the cut-off point moves closer to the mean; a point made evident in studies that adopt two cut-off points (i.e., Katusic et al., 2001; Stothard et al., 2013 [Table 2]). As expected, Stothard et al., (2013) found higher prevalence estimates when they adopted a 1SD (below the mean) cut-off (10.5% prevalence), rather than a 1.5 SD (below the mean) cut-off (3.9%). Snowling (2013) suggests a cut-off point of 1.5 SD for mild-moderate dyslexia and 2 SDs below the mean for moderate to severe dyslexia.

Table 2. *Prevalence estimates and methods used for identification of dyslexia in epidemiological studies.*

Study	Sample age (years)	N	Identification method (measure/s)	Cut-off point for classification	Prevalence by whole sample %	Prevalence by gender (if available)	
						Boys %	Girls %
Stothard, Snowling & Hulme (2013) [UK]	6 – 16	1553	**LAM** (York Assessment of Reading and Comprehension)	≥ 1.5 SDs below mean	10	-	-
				≥ 2 SDs below mean	3	-	-
Katusic et al., (2001) [USA]	5 – 19 years	5718	**LAM** (British abilities Scales II; British Picture Vocabulary Scales II)	≤25th percentile (≥ 0.67SDs below the mean)	11.8	13	6.5
			IQ-ADM	≥1.75SD below reading score predicted by score	5.3	6.3	2.1
				≥1.5SD below reading score predicted by	6.7	7.9	2.9
Rutter et al., (2004) Christchurch Health and Development Study NZ [NZ]	8 – 10	895 (50% male)	**LAM** Burt word reading test (New Zealand revision)	Lowest 15 %	15.2**	20.6	9.8
			IQ-ADM: Combined IQ scores across three ages	≥ 1 SD below reading score predicted on WISC-R score	14.1**	19.9	8.3
Rutter et al., (2004) Dunedin Multidisciplinary Health and developmental study [NZ]	7 - 11	989 (52.1% male)	**LAM**: Burt word reading test (New Zealand revision)	Lowest 15%	15**	21.6	7.9
			IQ-ADM: Combined IQ scores across three ages	≥ 1 SD below reading score predicted on WISC-R score	17**	24.6	8.9

LAM= Low Achievement Method (non IQ referenced reading disability); IQ-ADM= IQ-Achievement Discrepancy Method
** calculated from reported gender prevalence.

When comparing results from epidemiological studies (Table 2), prevalence rates appear lower for studies with a broader age range of participants (i.e., Stothard et al., 2013; Katusic et al., 2001). Developmental stages have been found to impact on the prevalence of identification markers of dyslexia in longitudinal studies (e.g., Morken, Helland, Hugdahl & Specht, 2017), therefore studies comparing specific age bands will possibly reveal variable and age-specific prevalence rates.

Issues are identified when comparing various methodologies in epidemiological studies. In two New Zealand studies (Table 2), a low achievement method (LAM) was compared with, the widely discredited, IQ-ADM. First, the identified sample of individuals will vary, as the LAM will address the tail end of distribution on reading achievement, whereas the IQ-ADM will not. Moreover, the LAM cut-off point in both of these studies is 15%; only one standard deviation below the mean, which will naturally over-estimate the prevalence of dyslexia, with some of these children falling just below the average range within the distribution. Given that poor reading achievement is identified as a key aspect of a dyslexia definition, the LAM is considered to be one of the valid criteria for the identification of dyslexia. However, this study wishes to emphasise the importance of the criteria going beyond 1.5 SD below the mean (as per the DSM-V recommendations) and settling on 2SD below the mean to identify moderate to severe dyslexia (Snowling, 2013).

The prevalence of dyslexia is suggested to vary across gender, showing dyslexia to be less common in girls (Katusic et al., 2001; Miles, 2004; Rutter et al., 2004; Stothard et al., 2013). However, Shaywitz, Shaywitz, Fletcher and Escobar (1990) found no gender differences for prevalence and argued that a referral bias is present in studies, where samples were drawn from clinic or teacher referrals. Shawitz et al., (1990) argued specifically that boys are more likely to be referred, due to disruptive behaviour. However, when ascertainment bias has been controlled through non-referred samples (Flannery, Liederman, Daly & Schultz, 2000; Quinn & Wagner, 2015), and epidemiological studies (Table 2), the findings suggest that the prevalence estimates for dyslexia amongst boys is at least twice that for girls.

The percentage of students identified as dyslexic arguably says more about the methodological criteria than about the prevalence of the disorder per se. Yet, since

dyslexia was officially acknowledged in New Zealand, our understanding of dyslexia has progressed, and so should attempts to identify the size of the issue in New Zealand. This study aims to do exactly that, through establishing a prevalence estimate within a non-referred sample of 8-10-year-olds. This will allow for more contemporary data than prevalence estimates provided by two earlier large-scale NZ studies (see Table 2). While this will potentially offer some insight into the size of the problem within Aotearoa, the breadth of difficulties experienced by these students with dyslexia is an area of research that has also been under-represented in New Zealand. With dyslexia gaining political prominence in education in New Zealand, it is now crucial to look beyond the specific reading difficulties inherent to dyslexia, to examine the broader literature related to dyslexia. The next section will focus specifically on the literature related to the behavioural correlates of dyslexia and frameworks for understanding these behaviours.

Dyslexia and Behaviour

A growing body of international evidence (Maughan & Carroll, 2006; Mugnaini, Lassi, La Malfa & Albertini, 2009) suggests that dyslexia often co-exists with internalizing behaviours: inward-focused emotional problems (Achenbach, 1966), as well as externalizing behaviour. Beyond studies examining general internalizing behaviour (Bäcker & Neuhäuser, 2003; Snowling, Muter & Carroll, 2007), the following internalizing behaviours have been associated with dyslexia: depressive symptomology (Heiervang, Lund, Stevenson & Hugdahl, 2001; Maughan, Rowe, Loeber & Stouthamer-Loeber, 2003; Willcut & Pennington, 2000); low self-esteem and depression (Riddick, Sterling, Farmer & Morgan, 1999; Terras, Thompson & Minnis, 2009; Willcutt and Pennington, 2000); and anxiety (Carroll, Maughan, Goodman & Meltzer, 2005; Carroll & Iles, 2006; Mugnaini et al., 2009). However, much research has focused on externalizing behaviour, especially with referred-samples, as it is usually observable and frustrating for educators (Heiervang et al., 2001; Maughan & Carroll, 2006). The relationship between dyslexia and externalizing behaviour appears to be epiphenomenal, rather than causal. It is estimated that up to 40 % of individuals with dyslexia meet the diagnostic criteria for ADHD (Maughan & Carroll, 2006; Willcutt et al., 2000), and that the inattention aspect of ADHD, rather than hyperactivity, is suggested to be the common factor between dyslexia and such behaviour (Willcutt et al., 2000). However, this is not the case for dyslexia and internalizing behaviour

(Carroll et al., 2005). Instead, school-based stress has been implicated as a risk factor for students with dyslexia developing high levels of internalizing symptomology such as anxiety (Maughan & Carroll, 2006). This study aims to narrow its focus towards anxiety and school-based stress to examine this relationship further. Before exploring existing research on dyslexia, anxiety and stress, it is first necessary to establish a framework within which to understand anxiety and stress.

Anxiety and Dyslexia

        Defining anxiety. Anxiety is described as, "A feeling of worry, nervousness, or unease about something with an uncertain outcome." (Oxford online English dictionary, n.d.-a). An understanding also exists that anxiety is an adaptive survival process (Ollendick & Horsch, 2007), which serves to protect us in uncertain contexts (King, Ollendick & Hagopian, 1997). However, anxiety is also represented somewhat differently, as typologies of state and trait anxiety (Spielberger, Gorusch, Lushene, Vagg, & Jacobs, 1983); test anxiety (Beidel, 1988) and subgroups or disorders (e.g., generalized anxiety, social phobia and separation anxiety; DSM-V, [APA] 2013), all of which have their own unique symptoms and definitions. For this study, it is the various domains of anxiety, roughly aligned to the DSM-V subgroups (see Appendix B), that we seek to explore, to elucidate how specific anxiety symptoms may vary across groups of readers.

        Five general theoretical approaches towards anxiety are identified within the literature: psychoanalytic (e.g., Freud, 1936); behavioural/learning (Dollard & Miller, 1950; Pavlov, 1927); physiological (e.g., Panksepp,1982), cognitive (Eysenk, 1990; Ohman, 1993), and uncertainty (Mandler, 1984). According to Freud (1936), anxiety is conceptualised as a consequence, or repression, which occurs when an individual is prevented from carrying out specific actions. Freud suggested that anxiety arises when the ego sends a signal of real or perceived danger, which then results in repression to escape the threat (Strongman, 1995).

        Behavioural theorists (e.g., Pavlov, 1927; Watson & Rayner, 1920), drew on a model of conditioned emotional response, whereby anxiety is considered a learned response mechanism to avoid undesirable stimuli. Physiological theories focused on bodily responses, proposing a *behavioural inhibition system* to exist, that regulates

emotions and behaviour when responding to a situation that is perceived to be threatening. The instinctive *fight or flight* response; described as 'escape' or 'forceful resistance' (Panksepp, 1982) was born from this theory. The physiological theory is useful at the level of observable behaviour and for studies examining physiological measures of anxiety (e.g., skin conductance as a physiological measures/ indicator of autonomic anxiety while reading aloud; Tobia et al., 2016). However, it is the cognitive approach to anxiety that is more relevant when describing the process by which anxiety may arise for a student with dyslexia.

Cognitive theories, such as that of Eysenck (1990) have dominated the literature, by conceptualizing anxiety as a significant volume or cluster of worry-schema stored in the long-term memory (Strongman, 1995). Ohman (1993) extended this concept to produce an information processing model of anxiety. The model fundamentally proposes that potential threat is detected, followed by 'significance evaluators' and 'expectancy systems' choosing an appropriate response/s to manage the perceived or real threat. Certain features of this model resonate with the image of a struggling student with dyslexia. Multiple times in the school day, the arousal system will magnify stimuli (e.g., reading aloud in class), which will then feedback an enlarged threat message to the significance evaluator. Consequently, the significance evaluator receives biased information from the expectancy system to react (perhaps a fight, flight or freeze response) when presented with information which is held in memory, of past experiences. The dyslexic student is likely to have experienced, and stored in memory, negative schemas regarding reading tasks in the classroom. Consequently, literacy tasks may be perceived as threatening; a perception that influences the conscious perception system to cause anxiety.

Mandler's (1984) theory of uncertainty, although broadly defined, is one that runs through all theoretical accounts of anxiety (Strongman, 1995). The uncertainty theory posits that arousal turns into anxiety when the individual has no means available to stop the arousal, leading to anxiety via helplessness. For example, the dyslexic child may struggle to perform in a timed comprehension test, losing meaning, as time and effort are spent laboriously decoding. There may be no actions available to this child to circumvent the challenge; their arousal levels may stay elevated and, anxiety may ensue. Mandler's theory is visible in all physiological, behavioural and cognitive theories, that may account for anxiety experienced by dyslexic students.

Measures of childhood anxiety. Various instruments exist for assessing childhood anxiety. However, not all of the instruments offer a range of anxiety dimensions and many (i.e., the Revised Childhood Manifest Anxiety Scale [RCMAS: Reynolds and Richmond, 1985]; the Child Behaviour Checklist [CBCL: Achenbach, 1991], and the State-Trait Anxiety Inventory [STAI; Spielberger, 1973]) have limited discriminant validity (Myers & Winters, 2002). State and trait anxiety (STAI), is often utilised in studies which measure anxiety levels during specific tasks (Carroll & Iles, 2006). In contrast, test anxiety tools (e.g., Test Anxiety Inventory: TAI, Spielberger, 1980) mostly pertain to high-school student research (Nelson, Lindstrom & Foels, 2015), and do not allow for examination of dimensions of anxiety. Silverman and Ollendick (2005) reviewed rating scales for anxiety in childhood but similarly concluded that the lack of representation of the dimensions of anxiety in the Diagnostic and Statistical Manual of Mental Disorders (4th edition.; DSM-IV; American Psychiatric Association [APA], 1994), reduced their utility. However, the SCAS (Spence, 1998a), utilised by Novita (2016) (see Table 3), is identified as a measure that maps most directly onto anxiety dimensions, represented by the DSM-V categories, therefore providing the researcher with anxiety measures across the domains.

Research studies examining dyslexia and anxiety. While there is significant research focussing on anxiety and dyslexia in adolescence (Carroll & Iles, 2006; Tsovili, 2004) and adulthood (Heiman & Precel, 2003; Jordan, McGladdery & Dyer, 2014; Klassen, Tze & Hannok, 2013), there is a relative paucity of studies that examine dyslexia and anxiety with primary aged pupils. Only eight published studies were identified to examine anxiety as a correlate of dyslexia, in primary-aged pupils, within the last two decades (Table 3), and only one study within New Zealand. There is the possibility of a publication bias in journals, with respect to anxiety and dyslexia; i.e., perhaps only those articles that have rejected the null hypothesis are published and are therefore not representative of the volume of work carried out in this area (Nelson & Harwood, 2011; Rothstein, Sutton, & Borenstein, 2005). Nevertheless, given the absence of such research attention, and the late and inconsistent acceptance of dyslexia in New Zealand, there is a need to explore the potential anxiety experienced by students with dyslexic-profiles in Aotearoa.

This field of research is fraught with methodological variability when assessing both dyslexia and anxiety (Table 3). First, many studies identify dyslexic groups from

clinic referrals (Davis et al., 2017; Mammarella et al., 2016; Novita, 2016; Dahle, Knivsberg, & Andreassen, 2011), which limits the generalisability of findings based on potential selection-bias. These students may have been referred to a clinic due to behavioural concerns as well as dyslexia, and potentially only severe dyslexic students are referred. Indeed, except for Carroll et al., (2005), the most significant results in this group of studies emerge from clinic-referred samples. There is a clear need for a non-clinic-referred population to be tested within New Zealand, to establish if Carroll et al.'s, (2005) findings can be replicated.

Secondly, across the eight identified correlation studies, six different anxiety measurement tools were adopted (Table 3). While some of these tests allow for specification across the relevant DSM anxiety sub-types (e.g., SCAS), others offer a limited number of anxiety subtypes (e.g., SAFA; Cianchetti, Fascello & Scale, 2001) and some tools provide only a total anxiety score (e.g., RCMAS; CBCLII, & BASC). While there is a reasonable consensus in the literature that dyslexia and anxiety are correlated, there is a need for research to contribute a greater understanding of symptomology and particular areas in which these students may struggle the most.

Thirdly, the source of information varies across these studies. For example, the study by Dahle et al., (2011) demonstrated parents to report higher anxiety for their children (d = 1.2) than teachers (d = 1.1), which in turn, was greater than anxiety reported by students (d = 0.5). This finding is supported by Heiervang et al., (2001), who found that children with dyslexia did not report differences in internalizing symptoms, whereas their parents did. They suggested that children were not able to recognize these characteristics in themselves. Parent reports might be necessary when assessing very young children, unable to express their internal anxiety (Langley, Bergamn & Paicentini, 2002). However, Boetsch, Green and Pennington, (1996), also draw attention to the importance of self-reports, as adults (e.g., teachers and parents) may be unaware of children's internal unobservable difficulties, especially in comparison to observable externalizing behaviours (e.g., Lamm & Epstein, 1992). Self-reports will first avoid the over-estimation of anxious symptomology observed in the literature to arise from adult reporting and secondly, to hear the child's voice at an age when the child can provide this, is of the utmost importance for ecological validity.

Table 3. *Studies investigating anxiety and dyslexia in children (1999-2019).*

Study	Country	Age range (years)	N D	C	Dyslexia classification	Anxiety measurement tool	Source	Anxiety Dimension	Results (Cohen's *d*)
Davis et al., (2017)	USA	7-12	22	21	Clinical diagnosis and **LAM**: <25th percentile on three-plus reading assessments.	RCMAS	Self	Total Anxiety	D > C *(0.86*)*
Mammarella et al.,, (2016)	Italy	8-11	15	15	Clinical diagnosis of RD: **LAM**: Impairment in decoding measured by reading speed (no cut-off)	SAFA	Self	Gen anxiety / Social anxiety	D > C (1.42**) / D > C (1.22**)
Novita (2016)	Germany	8-11	60	64	Clinical diagnosis: DSM-V criteria	SCAS	Self	Gen anxiety	D > C (0.42*)
Willcut et al., (2013)	USA	8-15	241	419	**LAM**: Standardised composite scores from battery of neuropsychological tests	DICA	Parent & Teacher	Gen anxiety	D > C (0.36*)
Dahle et al., (2011)	Norway	12	70	70	**LAM** clinic-based diagnosis based on Phonological deficit (no cut-off points described)	CBCL	Teacher & Self	Anxious / depressed	D > C (1.2**)
Carroll, et al.,(2005)	UK	9-15	289	5463	Discrepancy between vocabulary (BPVS-II) and word reading (BAS) (5% with greatest discrepancy)	DAWBA	Self	Gen anxiety / Sep Anxiety	D > C (0.69*) / D > C (0.79**)
Miller, Hynd & Miller (2005)	USA	6-16	20	59	**IQ-ADM:** ≥20 points between standard IQ (WASI) score and reading score (Reading standard score ≤85)	RCMAS	Self	Anxiety	*D <C (0.59)*
			24	55	**LAM**: cut-off point (<85 standard score in reading)				*D >C (0.04)*
Martinez & Semrud-Clikeman (2004)	USA	12+	30	30	**IQ-ADM**: (≥16 points) between IQ ability (abbreviated WISC) and achievement (WIAT: reading subtests)	BASC anxiety subscale	Self	Anxiety	D < C
Chapman (2004)	NZ	7	38	55	Discrepancy between listening and reading comp: IRAS listening (> 40th percentile) & IRAS Reading (<30th percentile).	CBCL	Teacher	Anxiety/ depression	*D >C (0.39)*

Differences between groups expressed as Effect sizes: annotated with P-values (* = p <.01; **= p <.001). According to Cohen's d, effect size 0.2 = small; 0.5 = medium and 0.8 = largeeffect (Cohen, 2013). Cohen's *d* effect sizes were drawn from reported results or calculated with use of an effect-size calculator (socscistatistics; psychometrica, n.d).

LAM = Low Achievement Method; IQ-ADM = IQ-Achievement Discrepancy Method.

Instruments used to measure anxiety: RCMAS: Revised Childhood Manifest Anxiety Scale (Reynolds & Richmond, 2000); SCAS: Spences Children's Anxiety Scale (Spence, 1988); CBCL – Achenbach Child Behaviour Checklist (1991); BASC: Behaviour Assessment System for Children (Reynolds & Kamphaus, 2002); DAWBA: Development and Well Being Assessment (Goodman et al); DICA – Diagnostic Interview for Children and Adolescents (Reich, Welner & Herjanic, 1997); SAFA: Self-Administered Psychiatric Scales for Children and Adolescents (Cianchetti & Fancello, 2001). *Instruments used to classify dyslexic group: BASII:* British Ability Scales II (BAS II; Elliot,Murray & Pearson, 1996) BPVS-II: British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley, 1997); IRAS-LC and IRAS – RC (Calfee & Calfee, 1981)WASI: Weschler Abbreviated Scale of Intelligence (Psychological Corporation, 1999); WISC: Weschler Intelligence Scale for Children (Weschler, 1991)]; 1phoneme deletion task (Olson, Forsberg, Wise et al., 1994).

Finally, it is perhaps unsurprising that the IQ-ADM, an invalid and unreliable identification methodology, would not reveal converging findings with studies adopting more contemporary methods. Seven out of eight identified studies showed the dyslexic group to have significantly higher anxiety levels than the control group (Table 3), except for the Martinez and Semrud-Clikeman (2004) and the Miller et al., (2005) studies. The Martinez study, which classified the dyslexic group by the IQ-ADM, revealed the opposite finding; the control group had higher anxiety than the dyslexic group. However, we know that the two methods would not identify the same cohort (see earlier discussion), so Martinez' findings can largely be discounted. Corroborating evidence exists in the study by Miller et al., (2005) (Table 3), who compared the self-reported anxiety levels of a control group with a group formed by the LAM and the IQ-ADM. While a significant difference between the groups for anxiety levels was absent for both methods, the direction between the groups did differ; whereby for the *low achievement* method, the dyslexic group had greater anxiety than the control group (although not significantly so), whereas the reverse was true for the IQ-AD. Despite the IQ-AD method generally being redundant and largely absent from research in the last decade, this serves to remind us to be cautious in drawing conclusions from studies with varying methodologies. While the heterogeneity of samples and methodology makes it challenging to compare associations across groups, overall, the international research suggests that readers with dyslexia are indeed at elevated risk of anxiety (Francis, Caruana, Hudson, & McArthur, 2019).

Within New Zealand, only one study (Chapman, Tunmer & Prochnow, 2004), has attempted to produce corroborating evidence in this field. Their study was part of a more extensive longitudinal study, which initially formed three reading groups utilising what appears to be, although is not specified as an SVR approach to classification (i.e., a discrepancy between above-average listening comprehension and below-average reading comprehension, with below-average word reading). The researchers used a real-word test (Burt Word Test), rather than a pseudo-word test as the decoding measure for meeting dyslexic criteria. Having found no significant difference between their *dyslexic* group and their *non-dyslexic poor reading* group on this measure, they then formed one combined poor reading group, which essentially means that within this sample, poor readers, not dyslexic readers, were reported to have significantly more anxiety than

typical readers. Had these researchers used a pseudo-word test (which avoids interference of learned words), a group difference may have emerged. A further issue with this methodology, is the reliance on teacher rating alone, for student anxiety measure, which may be open to reporting bias in the direction of over-estimation. There is a need for these shortcomings to be addressed in order to compare the anxiety profile of dyslexic children and other groups of readers within New Zealand. The present study aims to utilise a pseudo-word test to help operationalise the SVR, with students providing self-reports on the Spence Children's Anxiety Scale, to gain information on multiple anxiety domains.

Aetiology of anxiety correlating with dyslexia. Following the understanding of a general relationship existing between anxiety and dyslexia, it is necessary to consider the direction of this relationship. For example, the relationship between anxiety and primary school students with dyslexia could easily be assumed to be unidirectional when one considers the potential frustration and volume of time spent within the school context (Waters, Cross & Shaw, 2010). While there is no clear consensus on the direction of influence between dyslexia and anxiety, three models of aetiology are proposed.

First, Bandura's (1986) theory of social cognition, suggests that when faced with repeated academic failures, children with dyslexia develop anxiety as a result of negative interactions, feelings of inferiority, lack of self-efficacy in reading and the development of negative self-schemas (Bandura, Pastorelli, Barbaranelli, & Caparra, 1999; Carroll & Illes, 2006; Riddick et al., 1999). The basic premise is that in a society where enormous expectations are placed on school performance, students with dyslexia may be vulnerable to anxiety as a 'secondary' effect of dyslexia. Attribution theory and research (Frederickson & Jacobs, 2001) suggest that a strong internal locus of control may be a protective factor against the secondary effects of dyslexia. Moreover, longitudinal studies (Thomson, 1990; Burden, 2005) of pupils with initial below-average levels of self-esteem and self-concept upon entering specialist dyslexia schools, were found to increase towards the norm, over time and with academic progress. Therefore, from a social cognitive approach, school context and instruction is implicated as central to the amelioration of the secondary 'consequences' of dyslexia.

The 'cognitive approach' implicates an information processing bias and offers the interference model (Grills-Taquechel, Fletcher, Vaughn & Stuebing, 2012), which posits that anxiety interferes with reading progress. Convincing longitudinal research supports this theory for generic poor readers (Ialongo, Edelsohn, Wethamer-Larsson, Crockett & Kellam, 1994; Van Ameringen, Mancini & Farvoldern, 2003), but no such studies were identified for a dyslexic population.

A third more relevant causal theory is one that combines both theories; a bi-directional model. On entering school, a child may develop negative schemas concerning reading and anxiety may develop. Over time, as the student does not progress at the same pace as his/her peers, the gap may widen (i.e., the Matthew effect [Stanovich, 1986]), motivation may dwindle (Fulk, Brigham & Lohman, 1998), and the initial unidirectional cause develops into reciprocal causation (Grills-Taquechel et al., 2012). Research from the general population tells us that academic functioning and emotional perception do affect each other in a reciprocal way (Roeser, Eccles & Strobel, 1998). While analysis regarding the direction of causality is beyond the scope of this correlational study, a social-cognitive or bidirectional aetiology is considered a likely pathway for the development of anxiety in students with dyslexia. As such, this study gathered a sample from middle primary school, where such a causal pathway is expected to have begun.

Stress and Dyslexia

According to a social-cognitive developmental perspective, school-based stress should play a significant role in anxiety experienced by a dyslexic cohort. Therefore, before examining stress and dyslexia, it is essential to understand the nature of stress. Despite being an everyday amorphous term, stress has been defined as, "a state of mental or emotional strain or tension resulting from adverse or very demanding circumstances" (Oxford online English dictionary, n.d.-b), which represents a uni-directional *response*-based definition. According to D'Onofrio and Klesse (as cited in Helms, 1996), a stress response can manifest, similarly to anxiety, in a physiological, emotional or behavioural manner. The *stimulus* definition views stress as something external that impacts on the individual (Holmes & Rahe, 1967). The response-based model instead conceptualised stress as the physiological response that occurs when pleasant or unpleasant events unfold (Bauwens & Hourcade, 1992). However, both of

these models receive criticism, due to their neglect of the cognitive nuances of stress, such as individual appraisal and cognitive capacity to alter stress (Cooper et al., 2001). Most definitions of stress turned from *stimulus* and *response* definitions, towards relational and cognitive conceptualisations (De Anda et al., 1997).

Transactional stress theory. The transactional stress theory (Lazarus, 1980; Lazarus & Folkman, 1984) posits that stress develops when an individual evaluates their resources (through primary and secondary appraisal) to be insufficient to meet the environmental demands, and the individual then feels a threat to their well-being (Figure 3).
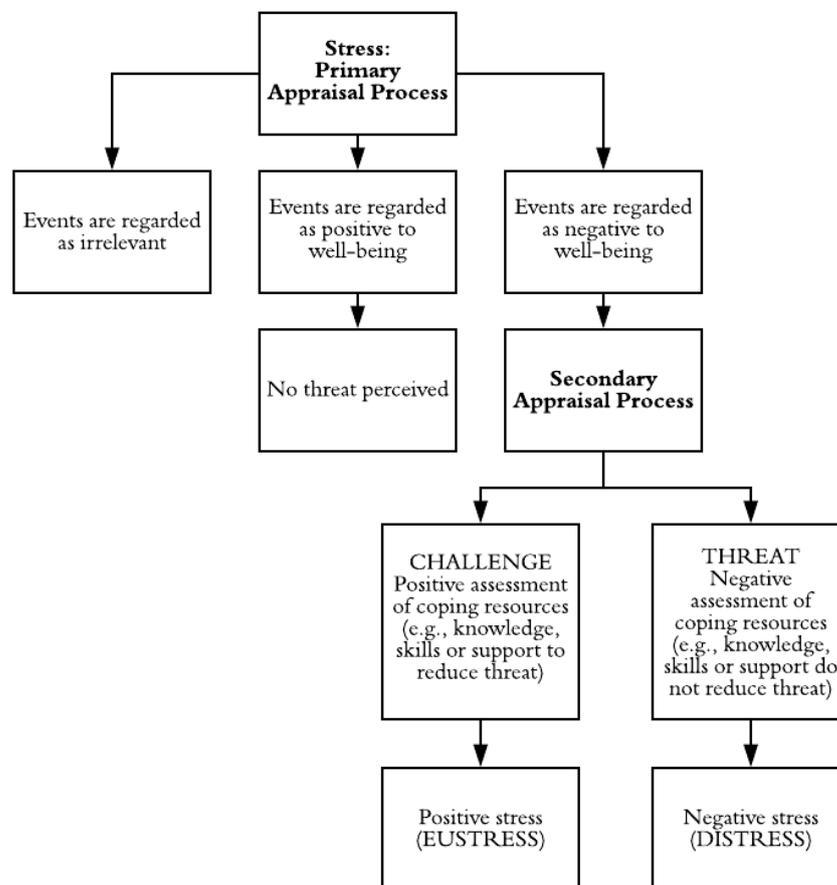
Figure 3. *Flowchart representing Lazarus' (1980) Transactional Model of Stress.*

The 'primary' appraisal process evaluates the event, and if a threat is perceived, the individual makes a second appraisal, to establish whether he or she has the resources to cope (Lazarus, 1980, 1999). This stress appraisal process involves the judgement of the controllability of the stress and the probability/predictability of outcomes. It is likely to be influenced by cognition, as well as context-related variables such as timing,

duration and frequency (Lazarus & Folkman, 1984). This transactional definition of stress is particularly pertinent to school-aged children, where varied pressures may come from interactions with parents or peer-group or teachers.

The relevance of Lazarus' model, is reflected in the following more contemporary definition of stress, that is adopted for this study: "A physical, psychological or social dysfunction that leaves individuals feeling unable to bridge the gap with the requirements or expectations placed upon them". The International Stress Management Association (2019).

School-related stress. Common sense and research (Seiffge Krenke et al., 2012) tell us that the school environment is likely to be stressful, at times, for students. As the transactional model (Figure 3) depicts, a certain degree of stress can be a positive influence, with the capacity to improve performance and well-being (*eustress*). However, students may experience stress from expectations that are too difficult to meet (Elias, 1989), where they perceive themselves to be lacking in coping resources, which may cause *distress* (Chandler, 1981, Selye, 1974). The *transactional model of stress* purports that when an individual perceives his/her coping resources will not be able to help deal with presenting stress, this negative stress can precipitate anxiety (Harpell & Andrews, 2013). Accordingly, to gain a full picture of potential school-based distress, or differences in distress, experienced by groups of individuals, it is helpful to examine anxiety alongside sources and manifestations of stress.

Studies examining dyslexia and school-related stress. Only two studies (Alexander-Passe, 2008; Helms, 1996) were identified in the literature to examine school-based stress amongst a dyslexic primary school cohort. First, Helms (1996) reports significantly greater manifestations of stress for a Learning Disabled (LD) group, across all manifestation scales and two sources of stress scales (peer interactions and academic stress). Similarly, Alexander-Passe (2008) claims to have demonstrated that children with dyslexia experience greater sources of school-related stress across all source scales (i.e., peer interactions, teacher interactions, academic stress and academic self-concept), as well as physical and emotional manifestations scales. However, despite both tests utilising the School Situation Survey (SSS; Helms & Gable, 1989), reliability and validity of findings is limited and difficult to compare or generalise, due to a lack of methodological rigour in both studies.

Firstly, Helms (1996) does not disclose where the school-based diagnosis for LD came from, nor the learning disability the LD cohort possess. While it is likely that there will be dyslexic students in this cohort, there are also likely to be other learning disabilities. A second issue, in terms of potential sampling bias, is that both samples are drawn from a clinic-referred population of students with dyslexia. Thirdly, with regards to analysis, the Helms study is open to Type 1 error, as a result of running multiple t-tests, whereas Alexander-Passe (2008) reports only descriptive statistics, yet discusses the results in the absence of any reported statistical significance. Without robust analysis, no claims can be made regarding the sources and manifestations of stress experienced by students with dyslexia.

Gaps in the Literature and Aims for this Study

Research in dyslexia has been plagued by inadequate and variable definitions and variable means of operationalising those definitions; all of which have undermined the very concept of dyslexia. While it is apparent that no single-level explanation will suffice for all purposes, the SVR model has emerged as a means for understanding and identifying a D-TP at the cognitive-behavioural level, using readily available classroom assessment tools (Nicholson & Dymock, 2015). This methodology for the identification of a dyslexic-type profile has not been demonstrated in the New Zealand research context and this study aims to fill this gap. There is also a paucity of studies examining anxiety and school-related stress in dyslexia with narrow age-range samples drawn from the general population, rather than clinic-referrals, and a void of such research in New Zealand. Finally, there is an absence of robust statistical analysis in studies examining stress in this age group of students with a dyslexic-type profile.

Chapter Three: Method

Introduction

This cross-sectional study employed a two-phase design and a descriptive quantitative approach to examine the prevalence of a Dyslexic-type profile (D-TP), followed by a quantitative analytical approach to compare the anxiety and stress experienced by this cohort in comparison to two peer groups. Following ethics approval being obtained, *phase one* involved data collection for the identification of a D-TP and other reading groups, as well as statistical data analysis to produce a numerical prevalence figure for a D-TP. *Phase two* involved data collection of participants' responses to two standardised quantitative surveys, measuring anxiety and school-related stress. Statistical data analysis was then carried out to establish if the dyslexic group reported significantly greater levels of anxiety and stress than the peer comparison groups.

This chapter outlines the methodological approach that underpinned the research and the methods employed to implement the study. First, the research focus is reiterated, to highlight the researcher's pragmatic philosophical stance. This is followed by an outline of the rationale for utilising a quantitative approach while operating under a combined pragmatic and post-positivist paradigm. The second part of this chapter describes the sample, instruments and procedures used for data collection and analysis. Methods are discussed alongside limitations inherent to the chosen methodology and considerations to ensure that the research was carried out in an ethical manner are introduced and discussed.

Research Focus.

The research began with an identified problem, that sprang from the researcher's observations and professional experience within the New Zealand context. Therefore, the aim was to explore the prevalence of a D-TP and the emotional experience of having this profile for 8-10-year-old students in New Zealand. Before describing the specific methods used to answer the research questions, the researcher considers it important to be explicit in outlining the paradigm position under which the research methods were chosen.

Research Design

Research design is best envisaged as a strategic framework for research, that sits between the research questions, the method and the data (Terre-Blanche, Durrheim & Painter, 1999; Punch & Oancea, 2014). In order to examine and understand social phenomena, social scientists may design their study with a quantitative, qualitative or a mixed-method approach in mind. While there is overlap, there are some different assumptions that accompany each approach. Bryman (2004) suggests research strategies to be distinguishable based on three differences in orientation: epistemological, ontological and orientation to the role of theory. Therefore, prior to outlining how the knowledge was gained for this research, in the *method*, the epistemology (i.e., the theory of knowledge guiding the research); the ontology (i.e., beliefs about the nature of reality); and the primary orientation to the role of theory will be explained and justified in relation to the research strategy.

A post-positivist paradigm influenced by pragmatism.

Epistemology. The term paradigm in educational research is succinctly defined by Mackenzie and Knipe (2006), as the researcher's worldview. In academic research, epistemology is intertwined with the scientific method, concerning the nature, origin and limitations of knowledge (Saunders et al., 2007), as well as the justification of truth claims. The key issue with regards to differing epistemologies is to decide what is the most acceptable knowledge, at this point, place and time in a given field, to answer the questions at hand. The following section will briefly contextualise the philosophical orientation of the researcher and paradigm position for this study.

A positivist epistemology assumes objective reality, independent of the observer, able to be measured and predicted (Orlikowski & Baroudi, 1991), with scientific explanation being central (Creswell, 2003). Positivist researchers search for regularities and relationships between variables (Bahari, 2010) and are grounded in the assumption that the best estimation of reality can be gained through the development of increasing the objectivity of the methodological approach. In a positivist paradigm, the researcher will usually search for a relationship based on cause and effect, correlation or

association (Arghode, 2012). It is, therefore, generally, quantitative research that arises from a positivist worldview that truth is observable and measurable (Merriam, 2002).

The quantitative approach to data collection and analysis that is evident at the method level of this study should, however, be viewed within a post-positivist framework, influenced by a pragmatic paradigm, at the methodological level. First, it is a post-positivist preference to answer research questions by utilizing methods (measures, techniques and procedures) that are best suited to the questions and the context (Creswell, 2013; Khumwong, 2004), rather than adopting a strict philosophical adherence to one paradigm. Secondly, as an educator, the researcher is deeply concerned with knowledge that is useful and indeed, which may help solve problems within education, in a pragmatic way. It is suggested by O'Leary (2007) that a pragmatic worldview perceives truth and value to "only be determined by practical application and consequences" (O'Leary, 2007, p. 206). To this end, the researcher considers herself a pragmatist and holds that this philosophical stance is visible in the research design, through the pragmatic orientation of the method towards the use of teacher-accessible tools and easily replicable method for the identification of a D-TP.

A post-positivist perspective suggests that research is the process of making claims, refining, or abandoning them while respecting all methods as necessary to develop knowledge (Clark, 1998; Fischer, 1998). For the present research, a post-positivist epistemology was considered appropriate for two reasons. First, this study seeks to establish an initial prevalence figure for a D-TP in New Zealand and the best fit for this research question is undoubtedly quantitative data collection and analysis. However, the researcher acknowledges the fallibility of truth claims with quantitative data collection and analysis and therefore places herself in a post-positivist paradigm. Similarly, initial data in relation to the emotional difficulties experienced by these students, when compared to peers, is being investigated. These questions require answers of significant difference, to support truth claims within New Zealand, which required quantitative data collection and analysis. Panhwar, Ansari and Shah (2017), suggest that research is conducted within a post-positivist paradigm, only when partial conclusions are made, and great emphasis is placed on recommending further research. Therefore, the researcher's decision to adopt quantitative methods for data collection

and analysis does not negate the usefulness of future qualitative exploration in response to questions two, three and four.

   Ontology. The 'objective' ontological perspective often attached to quantitative research is held in contrast to that of qualitative research that rises from 'subjectivism' (Bahari, 2010). Inherent assumptions that the social world is objective and that categories exist independent of individuals interacting in the world are adopted in quantitative research (Bahari, 2010; Easterby-Smith, Thorpe & Lowe, 2002). To the objectivist, reality can be found in measuring behaviour and the relationship between elements. Quantitative research holds assumptions that reality is not specific to the research context and therefore, can be generalized to larger populations for statements of truth (Bahari, 2010). An objective ontological perspective is seen as necessary for this research design, as it is the nature of the relationship among variables that it seeks to predict.

   The role of theory. While qualitative methods are considered inductive, in that theory generally develops out of observations, quantitative research is considered deductive (Bryman, 2004). In real terms, quantitative research is carried out with hypotheses; ideas drawn from theory and literature; and an inherent assumption that successive theories draw closer to a description of reality. The researcher has drawn from SVR theory (Gough & Tunmer, 1986) and literature specific to the New Zealand classroom (Nicholson & Dymock, 2015), purporting that proximal, rather than distal cause of dyslexia, best serves the purpose of identification. In quantitative research, theory is used deductively, as a framework for a study (Creswell, 2003) and theory is then tested or verified by the use of research questions and/or hypotheses. This research aims to utilise existing theory to test hypotheses, as opposed to generating theory from observations. Overall, the four research questions are more easily orientated to the deductive approach that is inherent in quantitative research. However, as a pragmatist, the idea that one research strategy is superior to another is irrelevant. The researcher is not a strict proponent of any philosophical stance and associated research methods. Rather, the researcher prefers to acknowledge the fallibility of truth and the need to adopt a post-positivist approach to truth claims.

   In summary, the research question relating to the prevalence of a D-TP required a quantitative response from a post-positivist and objective ontological perspective. The

research question aims to determine the predictable reality of the prevalence of a D-TP in the most objective way possible. While a post-positivist approach is undoubtedly necessary for the prevalence aspect of this study, it is also acknowledged that no one approach would provide a total view of the reality of the social world of the dyslexic-type student for questions two, three and four. The remaining research questions could arguably have been approached from a quantitative, qualitative or mixed-method design. However, as discussed in the literature review, at this point, there is a void in the New-Zealand specific literature of deductive and definitive evidence of the emotional challenges that face primary-aged students with this profile. Therefore, in response to the last three research questions, a deductive approach was prompted by international findings and deemed necessary.

Methods

This section of the chapter details the sample, sampling technique, ethical considerations, data collection and analysis procedures carried out in this study. Some inherent limitations of the chosen methods will be discussed. A diagram is provided (Figure 4) as a road map for the two phases and methods discussion.
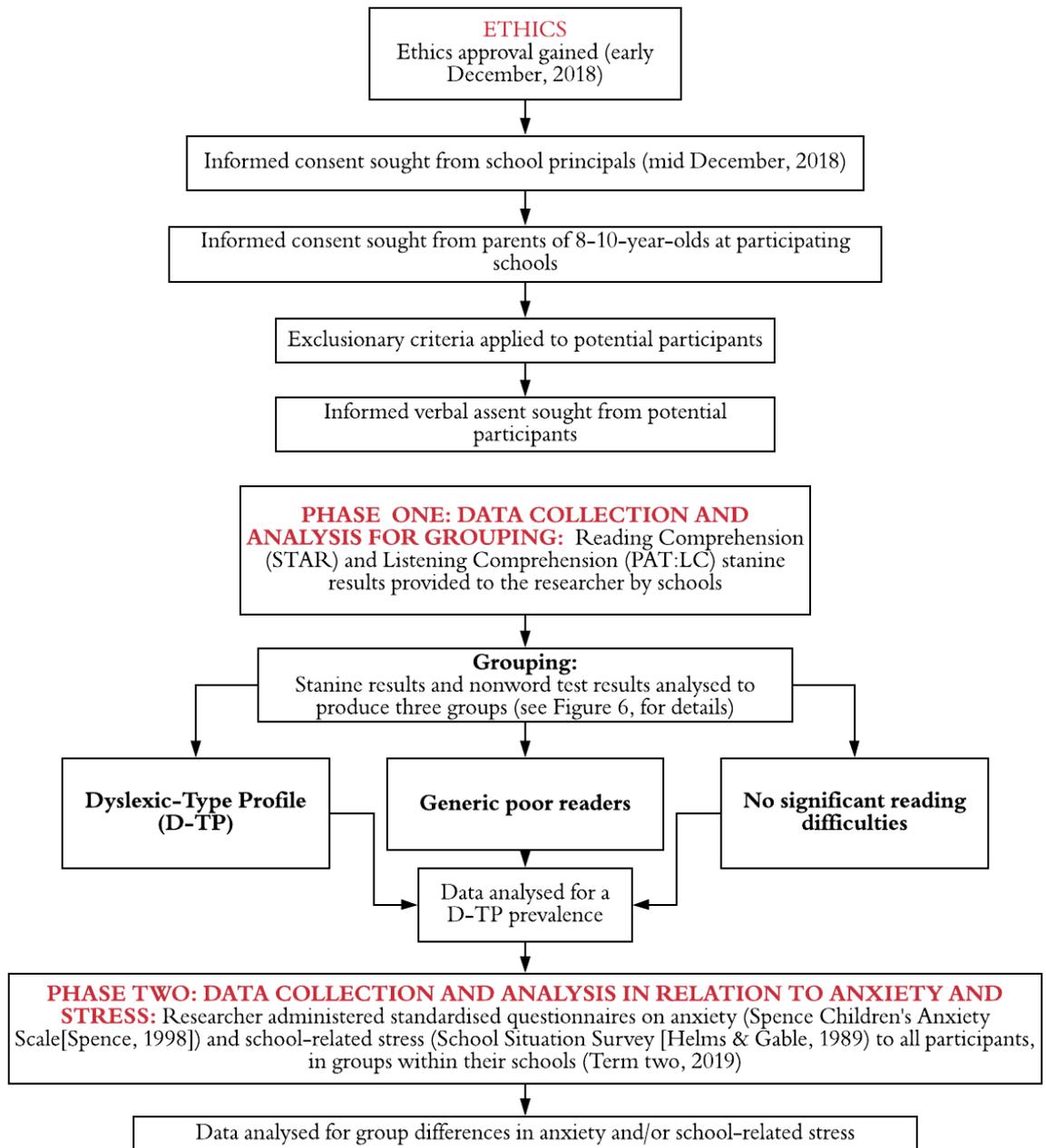
Figure 4. Two phases of research method.

The sample. It is acknowledged that it is impractical and not possible to examine all cases in a population (Durrheim, 2006). Therefore, a sample was invited to participate, that is believed to be representative of the population to be studied. The population being studied in this research was 8-10-year-old students enrolled in mainstream primary schools in New Zealand, and the sample was drawn from a cluster of this population.

Sampling technique. Non-probability convenience sampling was used in this study, whereby the researcher invited schools from within her locality to participate. Convenience sampling involves selection for an invitation to participate, based on ease of access to participants (Henry, 1990). Convenience sampling is suggested to reduce cost, travel time and time to collect data (Given, 2008; Teddlie & Yu, 2007). The locality for the research is a dispersed geographical area, which is logistically challenging. It was therefore convenient and manageable, to draw the sample from the two closest population centres.

A potential weakness of the convenience sample technique is that it is not random, and is therefore likely to reduce generalisability, by limiting the transferability of findings to the general population. However, there was a broad range of decile ratings amongst the participating schools (Figure 5). Decile ratings, range from 1-10 and are allocated to schools, by the Ministry of Education (MoE), based on socio-economic factors. Low decile schools, are generally set within lower socio-economic areas and vice-versa for high decile schools. The broad range of deciles is viewed to counter any concerns regarding generalisability from convenience sampling.

decile 2   decile 5   decile 6   decile 7   decile 8
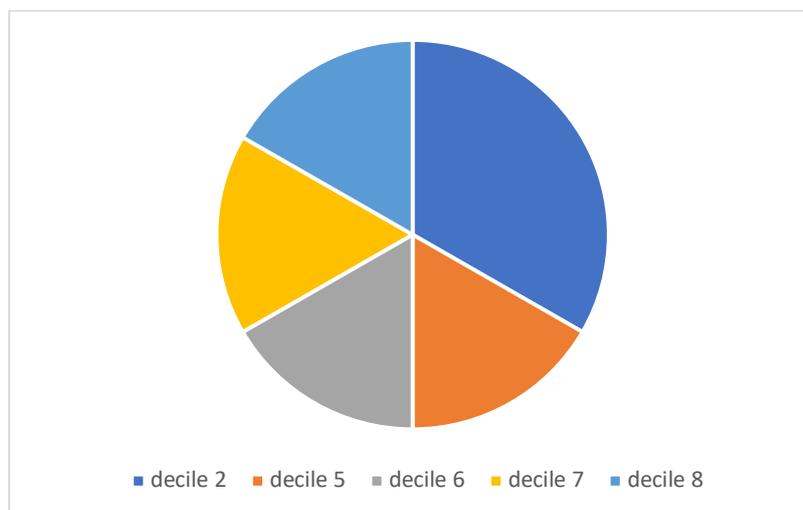
Figure 5. Decile ratings for participating schools.

As the primary criteria of the sampling technique was a willingness to participate, it was a possibility that parents may be motivated to consent to participate, or not, depending on their beliefs, or concerns, with their child's reading progress or anxiety. In other words, there was the possibility of a sampling error in the shape of a self-selecting sample. However, this self-selecting bias was hard to avoid due to the ethical necessity of voluntary participation.

Sample composition. The sample for the study consisted of 54 students in total, aged 8-10-years-of-age, from classrooms within New Zealand. The participants included 48% girls (N = 26) and 52% boys (N = 28). Exclusionary criteria are often employed to enable the researcher to investigate specific group differences (Rice & Brooks, 2004). In this study, the operationalised definition of a D-TP assumes a common symptom of dyslexia to be poor reading with a distinct profile that is specific to reading. Therefore exclusionary criteria were adopted to ensure students who would be expected to experience difficulties in reading for other significant reasons were excluded from the study, based on information provided in parental consent forms (see Figure 4). To facilitate this process, parents were asked to indicate, in their consent form, if their child had any of the following: English as a second language; speech and/or language delay; hearing impairment; vision impairment or developmental disorder. These factors were classified as exclusionary criteria. The sample composition for this study were participants whose parents did not disclose any of the aforementioned exclusionary criteria.

Ethics. Approval for the research was gained from Massey University Human Ethics Committee (MUHEC). (Appendix C: Ethics Notification: NOR 18/62). This section describes the ethical considerations.

Informed and voluntary consent. When carrying out research that consent of participants should be both voluntary and well-informed (David, Edwards, & Alldred, 2001). For this research, it was deemed necessary to fully inform and gain consent from multiple people, before obtaining verbal assent from the student participants.

First, the school Principals from 11 schools in a South Island (New Zealand) cluster were sent an information pack, which contained:

1. An information letter and invitation to participate, with a consent form for the Principal to sign (Appendix D). The information letter outlined the objectives; potential benefits of the research; commitment required of the school should they decide to participate; the procedures for consent and data collection that would follow their informed consent.

2. Assessment tools summary (Appendix E)

3. Copies of the parent/guardian information sheet and consent form (Appendix F)

4. Copy of the information sheet for classroom teachers (Appendix G)

5. Copy of the student participant information sheet (Appendix H)

Seven school Principals volunteered their schools to participate through signing and returning the consent form.

The next step was to seek parental consent for the identified potential participants to take part in the study. For potential participants under the age of fifteen years, MUHEC (2015) recommends that parent/guardian consent be sought in the first instance. Therefore, the school was provided with information packs to be delivered to all parents of 8-10-year-old students in their school. These packs included a detailed information letter; an invitation to an information evening and an informed consent sheet (Appendix F). The parents were asked to place their signed consent forms in a sealed box in the school office, to respect the confidentiality of the participants (MUHEC, 2015). Before the closing date for returning the consent forms, the researcher held three information evenings, where parents were invited to ask questions and view the assessment documents. Here, the researcher delivered a presentation of the study (Appendix I) and shared the questionnaires, in their entirety, for the parents to view. Only one parent attended each of the three evening information sessions. The return of the completed consent form indicated those parents who were willing for their children to participate. At that stage, a separate information sheet (see Appendix G) was also provided to the relevant classroom teachers.

Following written parental consent, the researcher sought informed assent from the students whose parents had consented to their participation. The researcher met with the students in each school, to introduce herself, explain the research project and gain

their verbal assent. In addressing the children, the researcher introduced herself and provided a brief personal and professional history. A summary information letter (Appendix H), prepared in age-appropriate language (as per MUHEC [2015] guidelines) was provided to the students. The researcher read this aloud to each school group of potential participants, to mitigate against any reading difficulties. The researcher explained the reasons for conducting the research, what exactly would be required of the students, should they choose to participate, and what was hoped to be gained. The researcher remained at the school for a break-period, to be available for further questions. Following this opportunity for questions and clarification, verbal assent was sought and recorded. Participants were assured that they had the right to refuse to participate and that they had the right to remove themselves from the study at any point up to two weeks after the final data was collected. Making the timeline explicit for withdrawal ensured that participants were aware of their ongoing right to withdraw their consent for their participation, up until this point.

Respect for privacy and confidentiality. Participants and their guardians were assured that the responses and personal details from the consent forms, school data and questionnaires would be kept confidential, with only the researcher and her lead supervisor having access to the information. To maintain the participants' privacy in their responses to the questionnaire, desks were separated, and students positioned themselves where their peers could not view their answers during the test administration. Forms were placed in a box, face down on completion of the questionnaire. The researcher then removed them from the classroom, ensuring the security of the forms. Participants were assured that their names would not appear in any written product of the research. The researcher herself has children that attend a local school, and it was decided to exclude this school from being invited to participate. First, this decision avoids any conflict of interest, and secondly, it avoids any breaching of the researchers' children's privacy, that would occur when the researcher, as a parent, would be aware of her children's responses. School Principals, teachers, parents and participants were assured that individual responses would be amalgamated so that no individual schools or participants would be identifiable.

Minimisation of risk of harm. When visiting the school to administer a follow up 1:1 assessment (the Martin and Pratt Nonword Test), it was explained to the whole

class that individual students would be called on to help the researcher as 'research assistants'. This was done to minimise any harm that may come from being singled out for additional assessment and to mitigate against the potential for those students feeling conspicuous.

It was considered that the process of completing and thinking about anxiety and school-related stress might potentially be expected to cause discomfort. The process through which this expression of emotion is planned for and managed is essential (Peled, 2001). Therefore, a safety plan (Appendix J) was put in place, that was to be implemented should a child become distressed when completing the surveys. Participants were again made aware that they could discontinue their participation.

While analysis at the individual level was not the intended purpose of this research, parents were given the option to be notified if their child met the criteria for a D-TP during the initial grouping and analysis of the data. If on the parental consent form, parents had opted to be informed of this possibility, the researcher notified the parents by letter (Appendix K). However, if a child's scores suggested anxiety levels that were significantly elevated from the published norms, the researcher automatically notified the parents by letter (Appendix L). Both letters contained additional helpful information. In determining what anxiety level would be considered to be significantly elevated above normal levels, Spence's (n.d.) recommendation of a T-score of 10 above the mean (a value of approximately one standard deviation above the mean, representing around the top 16% of the population) was adopted. Therefore, parents were informed about elevated anxiety if their child scored above 60 for a T-score in the Spence Children's Anxiety Scale (SCAS: Spence, 1998a). Within these letters, it was made explicit that this notification was non-definitive and non-diagnostic and that results may be a consequence of how the child was feeling on that particular day. Individual subscale results or responses to items from the questionnaires were not shared with parents in this communication, as participants had been given assurances that their answers were to be confidential (i.e., not shared with parents, teachers or anyone else, other than the researcher and her supervisors). Parents were instead guided to relevant support resources.

Treaty of Waitangi. Several values were considered in the method of this study. *He kanohi kitea* was demonstrated by the researcher meeting the students face to face,

to introduce the idea of the research. *Manaaki ki te tangata* (sharing and being generous) was demonstrated through the option of *giving back* information to parents of participants, highlighting that the researcher is not merely gathering data. The option for whānau to receive a notification of the presence of D-TP, and the notification of elevated anxiety, allows for whānau support and demonstrates sensitivity to cultural well-being. *Kaua e mahaki* is perhaps the strongest value demonstrated in this research, through the potential for growth in teacher awareness regarding the identification and emotional correlates of a D-TP.

Group classification. It must be acknowledged that all poor readers are not dyslexic. In the present study, three groups were identified; *D-TP, generic poor readers* and *readers with no significant* difficulties (Figure 6.). These terms refer to groups that have been operationally defined by the *Simple View of Reading.* This grouping was carried out largely in line with the recommendations set out for operationalising the SVR in the classroom, by Nicholson and Dymock (2015), whereby a *D-TP* is defined by a discrepancy in performance based on three set criteria:

1. A below-average achievement in a standardised assessment of reading comprehension (RC), with a stanine score of three or less.
2. An above-average achievement in a standardised assessment of Listening comprehension (LC), with a stanine score of six or above.
3. A below-average performance on a test of decoding (a standardised test of pseudo-word reading), with a stanine score of three or less.

Generic poor readers were defined as readers with no discrepancy, but below-average achievement, in both LC and RC. The *generic poor reading* group obtained an RC stanine of three or below, and an LC score at or below stanine five. Participants with *no significant reading difficulties* refer to those with RC and LC scores that were average or above, with stanine scores of four or above. Providing a degree of validity to the SVR classification of a D-TP, the students in this study who met criteria 1 and 2 for D-TP, also all met criteria 3.

| 1. Reading comprehension less than or equal to stanine three. 2. Listening comprehension score greater than or equal to stanne six | 1. Reading comprehension score less than or equal to stanine three. 2. Listening comprehension score of less than or equal to stanine five. | 1. Reading comprehension stanine score of greater than four. |

| 3. Nonword/pseudo-word score of less than or equal to stanine three. | | |

| Dyslexic-Type Profile | Generic poor reader | No significant reading difficulties |

Figure 6. Criteria for group classification.

Instruments

      Instruments used to group participants. Three measures of data collection were utilised to operationalise the reading groups, as the dependent variables: The Progressive Achievement Test: Listening Comprehension (Twist et al., 2010); the Supplementary Test of Achievement in Reading (Elley, Ferral, & Watson, 2011) and the Martin and Pratt Nonword reading test (Martin & Pratt, 2001). All measures were selected based on published reliability; validity; standardisation to ensure greater generalisability, as almost all instruments had norming samples from New Zealand; applicability and ease of administration with children.

      Listening Comprehension (LC). The Progressive Achievement Test: Listening Comprehension (PAT: LC) (Twist et al., 2010) was chosen as a New Zealand-normed assessment, explicitly developed for use in New Zealand schools to measure students' listening comprehension ability in response to texts that are read aloud. This assessment requires the student to *listen* for meaning, as opposed to *reading* for meaning, therefore the meaning displayed in item responses is independent of decoding ability. The PAT: LC is an individually administered standardised assessment of listening comprehension, that can be delivered at the whole class level. Students listen to passages read aloud to

them, through headphones and then answer multi-choice questions about the verbal information. The PAT: LC is designed for use with Years 3-10 and uses various writing genre items. The reliability coefficients from the norming tests were adequate (0.85 - 0.90). The results of this test were used to establish if students were above average, average or below average in their ability to comprehend spoken language, to part-operationalise the reading groups, as per Figure 6.

Reading Comprehension (RC). The Supplementary Test of Achievement in Reading: 2nd edition (STAR-II: Elley et al., 2011) is a standardised assessment tool, with published New Zealand norms. The NZCER publishes the STAR, which is designed to supplement assessments for students' progress and achievement in reading. The STAR has four sub-tests, assessing reading skills, including; sentence comprehension, paragraph comprehension, and vocabulary knowledge. Research concerning the STAR test shows evidence for validity and high reliability coefficients, with alpha statistics ranging from 0.93 – 0.96 (Elley et al., 2011). The STAR was chosen as it has been standardised for use in New Zealand and a previous edition has been used extensively in New Zealand-based research as a data-gathering tool to assess collective reading achievement across cohorts (e.g., Lai, McNaughton, Amituanai-Toloa, Turner, & Hsiao, 2009; Timperley, Annan, & Robinson, 2009). The star is designed for routine classroom administration for students from the beginning of Year 3 to the beginning of Year 9 and can be delivered at a whole class or individual level. The results of this test were used to establish students' ability to comprehend spoken language, to classify the participants according to three reading groups, as per Figure 6.

Decoding ability. A test of pseudo-word (or nonword) reading is often utilised as an indicator of decoding ability (Pressley, 2006). The rationale of nonword testing is that the 'unseen' aspect of these words mean that the reader cannot bring context, or lexicon knowledge to the task of reading but must instead rely on knowledge of ortho-phonic (text-sound) relationships. The researcher sought and was granted permission for the use of this test, and for including the test form in the appendices, by Professor Martin (see Appendix M).

The Martin and Pratt Nonword Reading test (Martin & Pratt, 2001) is a standardised test of nonword reading, with 54 nonword test items (see Appendix N for the test sheet and item example). It is listed in the New Zealand MoE website (Te Kete

Ipurangi, n.d.) as an assessment tool, verified for teachers to use, for Years 2-10. Not only does this signal the test as appropriate for the 8-10-year-old participants in this study, but also highlights the accessibility of the test for New Zealand teachers. Importantly, this standardised test allowed the researcher to ascertain a quantitative level of decoding ability, which other non-standardised nonword tests (e.g., the Bryant test of Basic decoding, [Bryant, 1975]) do not. While it is preferable that tests contain recent norms that are representative of the population being studied (Anastasi & Urbina, 1997), the closest geographical published norms for the appropriate age-group (Martin & Pratt, 2001), are considered adequate, as they come from a large Australian sample which is a closer match than the UK or the USA.

In a review of available nonword reading tests, this test appears within the top three for reliability (Colenbrander, Nickels & Kohnen, 2011), demonstrating high test-retest reliability and high internal consistency (Martin and Pratt, 2001). The reliability coefficients from the norming sample range from .92 - .96 (Martin and Pratt Nonword Test Manual, p.50). Additionally, the test achieves high criterion-related validity and demonstrates no floor or ceiling effects (Colenbrander et al., 2011). This test is a useful tool for collective assessment with students of a similar age to participants in this study, as demonstrated in previous research (Goff, Pratt, & Ong, 2005; McArthur & Bishop, 2004). This test offers two benefits in terms of minimizing intrusion into student learning. First, the test takes only 4-10 minutes to administer in a 1:1 setting. Secondly, while items are presented in order of difficulty, the test contains a stopping rule, whereby the test is discontinued after a certain number of errors, therefore minimising administration times and mitigating against the risk of frustration for children who have difficulty with the task. The results from the administration of the Martin and Pratt Nonword Reading test (Martin & Pratt, 2001) were utilised to help identify the D-TP readers, as per Figure 6.

Instruments used to measure anxiety and stress. To measure the independent variables of anxiety and school-related stress, the Spence Children's Anxiety Scale (SCAS: Spence, 1998a) and the School Situational Survey (SSS; Helms and Gable, 1989) were chosen. Rights for the use of, and the publishing of, the School Situation Survey were purchased by the researcher (from, https://www.mindgarden.com/140-school-situation-survey). While the SCAS is freely available for downloading and using

online (https://www.scaswebsite.com /1_61_.html), permission was sought and gained, from the author (see Appendix O), to reproduce the questionnaire as an appendix, for this thesis. In the following section, both instruments will be discussed, and their selection for use in this study justified.

The Spence Children's Anxiety Scale. The Spence Children's Anxiety Scale (SCAS: Spence, 1998), is a standardised, self-report, Likert-scale questionnaire that measures children's perception of the frequency with which they experience symptoms relating to various anxiety subtypes (see Appendix P for the full questionnaire). The SCAS was chosen as an instrument to measure anxiety for this study, for several reasons. First, the SCAS was developed to measure levels of anxiety symptoms based on the six dimensions of anxiety proposed by the Diagnostic and Statistical Manual of Mental Disorders (4th edition.; DSM-V; American Psychiatric Association [APA], 1994): *generalized anxiety, social phobia, panic/agoraphobia, separation anxiety, obsessive-compulsive* and *physical injury fears* (see Appendix B, for a full description of associated symptomology). This assessment allowed for specific dimensions of anxiety to be examined, rather than a global, trait or state anxiety score. Secondly, the SCAS was specifically designed for, rather than adjusted for, children (Novita, 2015) and is easy to administer to children, taking around 10 minutes. Students are asked to rate, on a 4-point scale, the frequency with which they feel they experience each item. There are 44 items, with 38 items describing symptoms of dimensional anxiety and a further six filler items to avoid response bias. Students respond with: never (0), sometimes (1), often (2), and always (3), to depict the frequency of symptomology, in their experience.

The SCAS psychometrics display adequate test-retest reliability and convergent validity (Essau, Sasagawa, Anastassiou-Hadjicharalambous, Guzmán & Ollendick, 2011; Spence, Barrett & Turner, 2003); and high internal consistency (Muris, Schmidt, & Merckelbach, 2000; Spence, 1998b; Spence et al., 2003). In the absence of New Zealand norms, the norms for the SCAS are considered adequate for validity, as they are based on a large community sample of Australian school children, aged 8-15-years-old, which is potentially more appropriate than UK or USA norms, which are likely to have more significant cultural differences and present a more substantial threat to the validity of findings.

The SCAS has been utilised in many studies to investigate anxiety symptomology and collective anxiety in a group. For example, the SCAS has been used to examine anxiety in children's perfectionism (Mitchell, Newall, Broeren, & Hudson, 2013); anxiety in children with Asperger's syndrome (Sofronoff, Attwood, & Hinton, 2005) and anxiety concerning maths achievement (Walker, 2013). This project has adopted the SCAS as a tool to provide an indication of the dimensions and extent of anxiety symptoms between groups.

The School Situational Survey. The School Situational Survey (SSS; Helms and Gable, 1989) is a Likert-style, self-report questionnaire developed to measure particular sources and manifestations of stress in children (see Appendix Q to view some items). The SSS includes two broad domains; stress sources (four subscales) and stress manifestations (three subscales). As described in the manual (Helms and Gable, 1989), reliability coefficients for the various scales are moderate to high, ranging from .68 - .80 based on a large (N= 7036) primary-aged sample (Gable, 1986). Factor analytic reports demonstrate adequate validity of the seven-dimensional structure of the SSS (Helms and Gable, 1990). Significant positive correlations were demonstrated with the SSS scales and the State-Trait Anxiety Inventory for Children (STAIC; Spielberger et al., 1973) on a sample (N = 1111) of children (Helms and Gable, 1990), further demonstrating the construct validity of the SSS. Although created in 1989 and developed for individual administration, this survey has been utilised more recently (Alexander-Passe, 2008), to assess sources of stress, for a cohort of students, with similar age range to this study, with dyslexia; and for a cohort of students identified as having emotional or learning disabilities (Helms, 1996). Both the documented reliability findings and the use of the SSS with both dyslexic and similar-aged participants demonstrates the SSS to be a reliable tool for research purposes and use with the intended age-group of participants in this study.

The SSS contains four scales, classified by Helms (1996) as *sources* of stress and three scales classified as *manifestations* of stress. The four sources of stress subscales, provide four areas within the school context that a child may report to find stress-inducing. Whereas the manifestation subscales provide three ways in which an individual may report to respond to stress. The sources of stress include stress in relation to: *Teacher Interactions:* students' understanding of their teachers' feelings

towards them and potential stress resulting from their interactions with their teachers; *Academic Stress*: situations that relate to academic performance; *Peer Interactions:* students' social interactions or their perceptions of their peers' feelings towards them; and *Academic Self-concept:* students' feelings of self-worth, or self-concept in relation to academic ability (Helms, 1996). The manifestations of stress include stress that manifests in the following ways: *Emotional manifestations*: feelings such as fear and loneliness; *Behavioural*: stress in relation to one's actions or behaviour towards others; *Physiological:* physical reactions such as nausea, tremors or rapid heartbeat (Helms, 1996).

The SSS questionnaire is easy and quick to administer to children, typically taking around 10 minutes. Young people are asked to respond to 34 items, and rate each symptom on a 5-point Likert scale: never (1), rarely (2), sometimes (3), often (4), or always (5), depicting how often they experience the dimensional symptomology. The test is hand-scored, through the use of an acetate scoring key, which allows the reverse-scored items (N= 9) to be easily identified and accurately scored. Students who score highly on any one of the subscales are likely to be experiencing stress in relation to that scale.

Procedures

Data collection for grouping. All participants completed the STAR and PAT: LC within their regular classroom programme. The STAR and the PAT: LC assessments had been administered to the whole class by the classroom teachers at the participating schools, as routine assessments before the end of term one, to comply with norming restrictions. Specifically, when using stanine data for results on both of these tests, it is important to consider that the original norming studies were carried out in March. Therefore, for the valid use of stanine scores, testing must occur around this time (i.e., term 1).

Classroom teachers followed standard testing procedures in administering and scoring these assessments, which lasted between 30 and 40 minutes. Raw test scores were converted to stanines, by the classroom teachers, using the score conversion tables in *The STAR Teacher Manual* (Elley et al., 2011) and *The PAT: LC Teacher manual* (Twist et al., 2010), which provides stanines for all year levels. Stanine data for all

participants' scores on both assessments were then supplied to the researcher by the Principal, before the end of term one.

Only those that met the first two criteria for the D-TP group (Figure 6) were asked to complete the third step Martin and Pratt Nonword test (Martin & Pratt, 2001). The researcher administered this assessment in a 1:1 setting in a place and time that was scheduled to suit the classroom teachers and cause minimal disruption to participant learning. This test was scored according to standardised scoring procedures. Raw test scores were converted to percentiles, according to the test manual and then converted to stanine scores by the researcher. This third step confirmed a decoding deficit to be present for all of the students identified with a discrepancy between their reading and listening comprehension.

Data collection for anxiety and stress dimensions. Once grouping was completed, all participants completed the SCAS, followed by the SSS. The researcher visited each of the six schools to administer the two questionnaires in one sitting at each school. On each occasion, the students were introduced to the testing procedures. It was explained that the researcher would read each question aloud and that they were to circle the number that reflected their response to each question. Items were read aloud to circumvent any difficulties students may have with comprehending the text, as recommended by Spence (1998a). Individual item responses within each subscale of the SCAS and the SSS were averaged to produce a subscale score.

Analysis of Data. Data analysis was carried out in response to each research question, using the Statistical Package for Social Sciences, version 22.

Grouping and Prevalence. Criterion-based, cross-sectional analysis of the participant data from the STAR, the PAT: LC and the Martin and Pratt Nonword Test was carried out to establish three groups. The class teachers compared the raw data from the PAT: LC and the STAR to the norm groups provided within each test manual, to provide stanine scores. This data was analysed by the researcher, to form three groups, based on stanine results (Nicholson and Dymock, 2015). Stanine results are meaningful, in this context, as they allow for generalisability to a similar national representative groups of students. As discussed previously, the PAT: LC and the STAR are both New Zealand-normed, whereas the Martin and Pratt Nonword Test is Australian-normed.

In order to describe the sample and to assess whether age was equally distributed across the sample and the groups, Shapiro-Wilk's test (Shapiro & Wilk, 1965) was carried out, as well as visual inspection of histograms, Q-Q plots and box plots, to check for significant outliers. The sample was then described by calculating the mean; standard deviations, based on the assumption of normal distribution; minimum and maximum for the variable *age* and by calculating frequencies and percentages for the categorical variables of *gender* and *group*. A Chi-square test of independence was performed to test whether the three groups were equal by gender. One of the assumptions for performing multivariate analysis of variance is to have a larger number of participants than the number of dependent variables being analysed. As there were only two girls with a D-TP, it was not appropriate to combine *gender* and *group* in the same analysis with multiple dependent variables. Therefore, univariate analysis of variance was performed to test whether the three groups and the two genders were equal by age, using gender as the independent variable and age as the dependent variable.

Prevalence of D-TP was identified by calculating the number of children meeting the three D-TP criteria (numerator) divided by the total number of participants (denominator).

Anxiety and Stress. Initial analysis of the SCAS and SSS data was performed, to establish reliability and intercorrelations of the subscales and to provide descriptive data for the whole sample. Mean response scores, standard deviations and range of scores within groups for each of the anxiety dimensions and each of the stress scales was calculated. Due to the ethical consideration to inform parents if their child displayed elevated anxiety, individual SCAS total anxiety T-scores were calculated and analysed for elevated anxiety. In this study, a total SCAS T-score of sixty or more, as recommended by Spence (n.d.), was considered to be significantly elevated.

Age and *gender* differences were tested for all stress and anxiety variables using one-way multivariate analyses of variance, with *gender* as an independent variable and *age* as a covariate. The average response scores for each scale were analysed using one-way multivariate analyses of variance to determine if any group differences existed. Before performing each analysis of variance, the following assumptions were tested (for further details see Appendices W, X, Y and Z):

1. The sample size was tested, as more participants were required per cell than the number of dependent variables.

2. Univariate normality of dependent variables and lack of outliers was tested by calculating standardised skewness and kurtosis, running Kolmogorov-Smirnov and Shapiro-Wilk normality tests, drawing histograms and box-plots with outliers.

3. Multivariate normality of dependent variables and lack of outliers was tested by running multiple regression analysis with dependent variables from the multivariate model as independent variables, and participants' identity number as a dependent variable, and thereby calculating Mahalanobis distances to identify outliers.

4. The Linear relationship between dependent variables in each category of independent variable was tested by drawing scatter matrices.

5. Multicollinearity and singularity were calculated using Pearson correlation coefficients among dependent variables; correlations should not be too low, and not too high.

As there were seven stress subscales, and the smallest group had $N = 6$ participants (D-TP Group: see Table 5), it was appropriate to separate the four stress sources and the three stress manifestations for analysis. Therefore, the following three multivariate analyses, rather than two, were used for testing for significant differences in stress and anxiety subscale scores, with *group* as the independent variable:

1. A multivariate analysis was performed with the six anxiety variables as the outcome variables: *separation anxiety*, *social phobia*, *obsessive-compulsive*, *physical injury fears*, *panic-agoraphobia* and *generalised anxiety*.

2. A multivariate analysis was performed with stress sources as the outcome variables: *teacher interactions*, *peer interactions*, *academic stress*, and *academic self-concept*.

3. A multivariate analysis was performed with stress manifestations as the outcome variables: *emotional*, *behavioural*, and *physiological*.

Following significant multivariate analyses, follow up univariate analyses (ANOVAS) were carried out to identify the specific significant group difference(s). Due to the lack of statistical power that accompanies a small sample size and the increased risk of a type II error (i.e., retaining the null hypotheses with regards to further anxiety dimensions), a second round of statistical analysis was carried out. This second round of analysis involved a series of *t*-tests being performed on the data to establish the presence of between-group differences on the stress and anxiety subscales, as a function of group. The independent variables in these t-tests were reading group and the dependent variables were the average response of the group on the subscales of the SSS and the SCAS. The researcher was interested in whether there were significant differences between groups on any of the dependent variables (subscale average responses). Differences between the groups were expressed as *p*-values and effect sizes were calculated for these differences.

Effect sizes were calculated for *all* significant results, to gauge the practical significance of findings and to allow for comparison of findings with those of international studies. Effect sizes (Cohen's d) were calculated from the following comparison:

$$d = \frac{Mc - Md}{(SDc + SDd) / 2}$$

Mc is the mean for the peer comparison group; Md is the mean score for the D-TP group; SDc is the standard deviation for the peer comparison group, and SD is the standard deviation for the D-TP group. According to Cohen (2013), 0.2 represents a small effect size, 0.5 is a medium effect size , and 0.8 is a large effect size.

Summary

The method had two distinct stages. First, data from participating schools were collected to establish the listening comprehension and reading comprehension demonstrated by 8-10-year-old participants. Those participants who displayed above-average scores in listening comprehension and below-average scores in reading comprehension then completed a test of decoding (the Martin and Pratt Nonword Reading test [Martin & Pratt, 2001]). Following this data collection, three groups were identified utilising the SVR, as outlined by Nicholson and Dymock (2015): Group 1.

Students with above-average listening comprehension, below-average reading comprehension and below-average decoding ability (i.e., a D-TP); Group 2. Students with below-average reading and listening comprehension (i.e., generic poor readers); and Group 3. Students with above-average reading comprehension (i.e., no obvious reading difficulties). All participants completed a questionnaire to investigate self-reported anxiety (the SCAS) and a questionnaire to investigate sources and manifestations of school-related stress (the SSS), to allow comparison of subscale results across the three identified groups. In this chapter, the researcher provided an outline of the research design, sampling, ethical considerations, instruments, data collection and analysis procedures. In the next chapter, the findings are presented.

Chapter Four: Results

Introduction

This chapter presents the findings from the quantitative data collection and analysis used to test the research hypotheses. The results will be presented sequentially in response to the four research questions and associated hypotheses. First, the results from the data collection, grouping and analysis will be reported, in order to answer the first research question and gain a prevalence estimate for a *D-TP*. The reliability, descriptive results and intercorrelations from the stress and anxiety scales will then be presented, before presenting the results of analyses regarding the three remaining research questions and hypotheses.

Sample and Grouping

Sample. An invitation to participate in the study was sent to eleven school Principals in the South Island of New Zealand. Four Principals declined to participate, citing reasons such as current workload; or their school did not run the assessments required for the study. A total of 218 letters of invitation were sent to the parents of 8-10-year-olds within the remaining seven schools. Informed parental consent was provided for sixty-seven children to participate in the study. Students were removed from the study, in the absence of parental consent, or due to meeting exclusion criteria such as visual impairment (N=1); developmental disorder (e.g., ADHD or autism) (N=4) and one participant who was outside the age range (N=1). Further students did not assent to participate following a student information session and were removed from the study (N=2). An additional student (N=1) was excluded due to the STAR test and the PAT: LC test data being completed outside the timeframe for the valid use of these tests' stanine results (i.e., term one). This also resulted in one school being removed from the study as there were no longer any participants from that school. Further participants (N=4) were excluded from the study during the assessment gathering phase, due to repeated absence, when the researcher was data-gathering at their school. In total, N = 54 students, from six schools participated in the study (Figure 7).

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┌─────────────────────────────────────────┐
│    Total number of children's parents    │
│                contacted                  │
│       N =218 from seven schools           │
└─────────────────────────────────────────┘
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┌──────────────────────────────────────────┐
│  Excluded = 163                            │
│    • No parental consent =155              │
│    • Developmental disorder = 4            │
│    • Visual Impairment =1                  │
│    • Out-with age range = 1                │
│    • No child assent = 2                   │
│  N= 55 from seven schools                  │
└──────────────────────────────────────────┘
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┌──────────────────────────────────────────┐
│  First level of assessment:               │
│  PAT(Listening Comprehension) and         │
│  STAR (Reading) stanines gathered          │
│  from Principals for grouping              │
│  participants                              │
│             N = 55                         │
└──────────────────────────────────────────┘
```

```
┌──────────────────────────────────────────┐
│  Excluded = 1                              │
│  PAT / STAR Assessment data completed      │
│  by school out-with time of year for normed│
│  data/validity.                            │
│  N=54 from six schools                     │
└──────────────────────────────────────────┘
```

```
┌──────────────────────────────────────────┐
│  Selected for second Level of              │
│  assessment: Martin & Pratt Nonword        │
│            Reading Test                     │
│               N=6                           │
└──────────────────────────────────────────┘
```

```
┌──────────────────────────────────────────┐
│            Group 1                          │
│      Dyslexic-Type Profile                  │
│            N = 6                            │
└──────────────────────────────────────────┘
```

Figure 7. Flow chart for identification of a dyslexic-type profile.

Prevalence of D-TP.

Research question one: What is the prevalence of a D-TP in eight to ten-year-old primary school students in New Zealand? Prevalence estimates logically depend on definition, as previously discussed. In this study, three necessary criteria were used to define the presence of a D-TP (see Figure 6). For the first criterion to be met, a student would score one, or more, standard deviation below the mean for the STAR Reading test (i.e., a stanine score of ≤ 3). According to this criteria, seventeen

out of fifty-four students (30% of the sample) met the first criterion for having a D-TP (Figure 8), of which there were eight females and nine males.
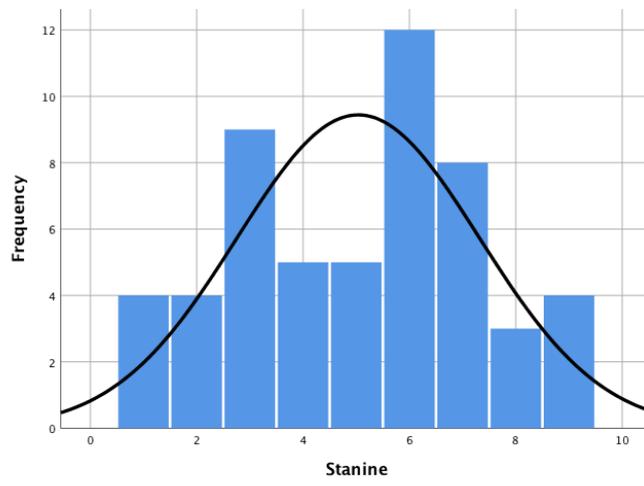
Figure 8. Frequency and distribution of STAR stanine scores across the participants.

A comprehension discrepancy must be evident to meet the second criterion. Specifically, students that met the first criterion (of below-average reading ability, according to their STAR stanine) needed to display an above-average ability in Listening Comprehension (i.e., gain a result of $\geq$ stanine 6 in the PAT: Listening Comprehension Test). Out of those seventeen students that met the first criterion, six were identified as meeting the second criterion condition (Figure 9), including four males and two females.
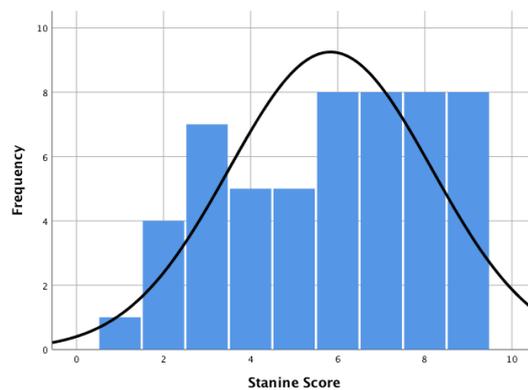
Figure 9. Frequency and distribution of PAT: LC stanine scores across the participants.

The remaining six students were tested on the word reading skill of phonological decoding, using a pseudo-word test (the Martin and Pratt Nonword Test [Martin & Pratt, 2001]), to identify students who performed below average. To meet this third criteria, the students scored one, or more, standard deviation below the mean (a score of

≤ 23rd percentile) in this decoding skills assessment. All six students were tested and scored beneath this cut-off point (Table 4), therefore were considered to display a D-TP.

Table 4. *Standard scores and percentile scores for the Martin and Pratt Nonword Test (Martin & Pratt, 2001)*

| Participant | *Martin and Pratt Nonword Score* | |
	Standard score	Percentile
1	74	4
2	66	1
3	76	5
4	86	18
5	85	16
6	85	16
Total Mean Score	78.67	10

N=6

The key outcome measure for this results section is the prevalence of dyslexia, calculated with the numerator as the number of children confirmed positive for a D-TP after the second level of data collection (N=6) and the denominator being the total number of participants within the study (N=54). For this sample, the prevalence level for a D-TP, according to the defined criteria-set was 11%.

Sample description and groupings. The entire sample included N = 54 children, with 48% girls and 52% males. The average age was 9.5 years-of-age (SD = .85), with the youngest child aged eight years, two months and the oldest aged ten years, ten months. Participants were grouped into one of three groups (*D-TP, generic poor readers* or students with *no significant reading difficulties*) according to their results in the screening process (Figure 10).
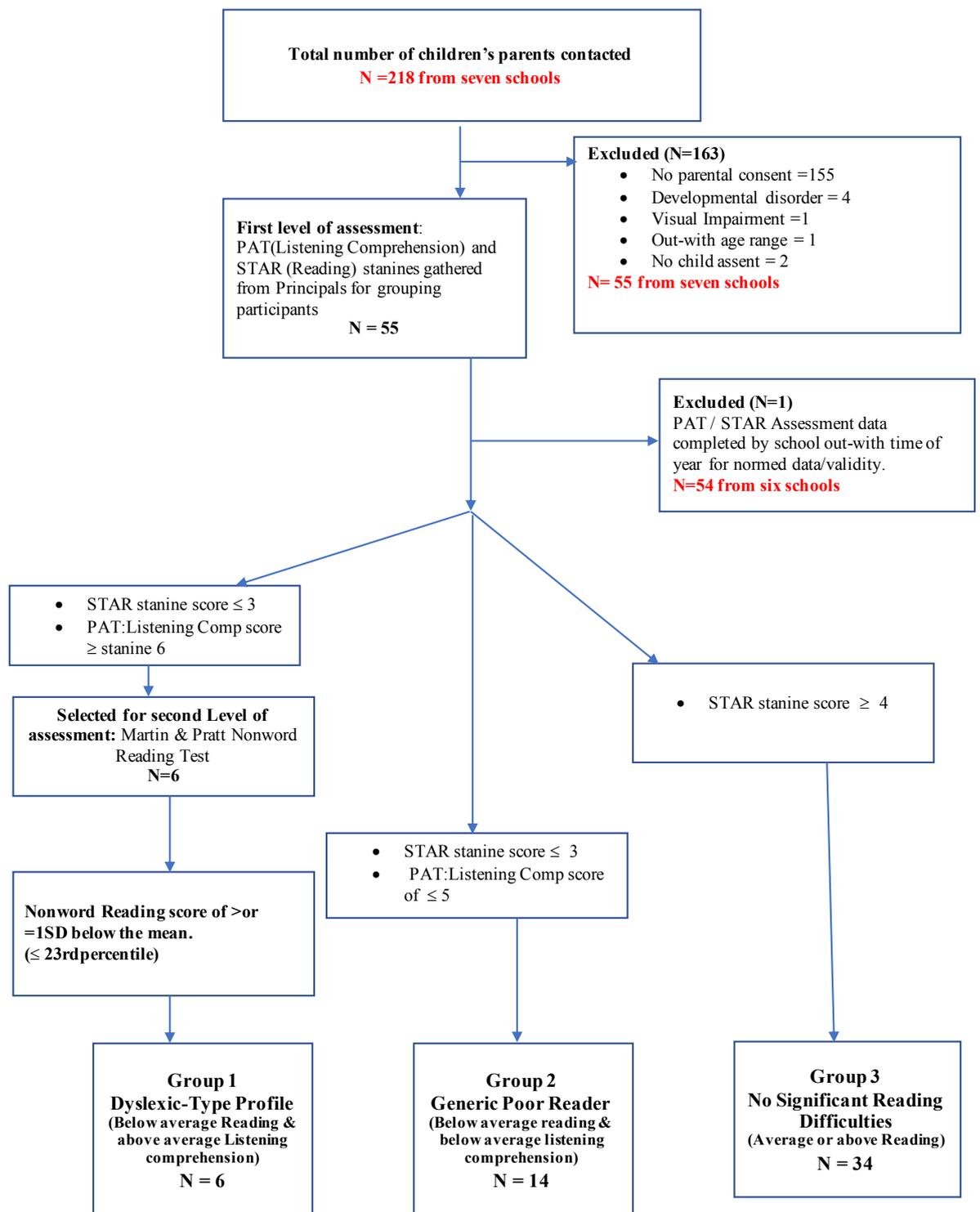
Figure 10. The Screening process and results for grouping.

The screening process (Figure 10) allowed the sample to be grouped according to set criteria. The distribution of participants across the groups is displayed (Figure 10), and the frequencies of females and males alongside average age in each group is presented (Table 5).

Table 5. *Age and gender characteristics for each reading group.*

Group	Female			Male			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
D-TP	2	9.95	.071	4	9.42	.888	6	9.60	.740
Generic poor readers	9	9.56	.828	5	9.20	.927	14	9.43	.847
No reading difficulties	15	9.91	.826	19	9.29	.858	34	9.56	.887
Total	26	9.79	.795	28	9.29	.842	54	9.53	.850

Pearson's Chi-squared test of independence indicated that there was no association between *gender* and *group*, $X^2(2) = 2.21$, $p = .33$. However, two cells had N < 5, therefore the Freeman-Halton extension[1] of the Fisher exact probability test (Freeman & Halton, 1951), was run instead. The probability of the observed array of cell frequencies plus the sum of the probabilities of all other cell-frequency arrays (such as would be consistent with the observed marginal totals) that are *equal to or smaller* than the probability of the observed array was $p = .37$. Therefore the proportion of each gender was not considered to be unequal for the three groups.

Following a univariate analysis of variance (ANOVA) of age, with *reading group* and *gender* as independent variables, the age of children was found to be not associated with *reading group* (F (2,48) = .39, p =.68, partial η^2 = 0.02); *gender* (F (1,48) = 2.68, p = .11, *partial* η^2=.05) or *reading group* x *gender* interaction. (F(2,48) = .11, p=.89, partial η^2=.005). Therefore it was concluded that gender and age are not associated with any reading group in this study (i.e., were not unequal within the reading groups).

Reliability of Anxiety and Stress Dimensions

Descriptive statistics, reliability and intercorrelations of the anxiety dimensions. The sets of items within the SCAS were analysed to see how closely related they were as groups within each subscale (i.e., to establish whether the subscale items that propose to measure the same general construct produce a similar score). This analysis is necessary to establish adequate reliability of the subscales for this sample

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[1] Performed on the following website: http://vassarstats.net/fisher2x3.html

and to compare the findings with published reliability figures. Reliability was high, with Cronbach's ∝ internal consistency coefficients of the SCAS subscales ranging from .61 to .90 (Table 6). These results are comparable with reported internal consistency coefficients of the SCAS, which ranged from .60 to .80 (Spence et al., 2003). Participants scored highest in the *generalised anxiety* subscale (Mean of 1.07) and lowest in the *panic-agoraphobia subscale* (Mean of .48). Almost all anxiety dimensions/ subscales were moderately to highly positively correlated (Cohen, 2013).

Table 6. *Descriptive data, intercorrelations, and internal consistency coefficients (in parentheses) of the SCAS anxiety subscales (averaged Likert scale scores).*

Spence Children's Anxiety Scale Results												
		Descriptive				*Intercorrelations*						
Anxiety variable	*n*	Min	Max	Mean	SD	1	2	3	4	5	6	7
1.Total SCAS Anxiety	38	.11	2.13	.87	.430	(.90)						
2.Separation anxiety	6	.00	2.33	.96	.555	.80**	(.66)					
3.Social phobia	6	.00	2.83	.92	.680	.84**	.69**	(.79)				
4.Obsessive-compulsive	6	.00	2.17	.84	.563	.75**	.47**	.57**	(.62)			
5.Physical injury fears	5	.00	2.80	.94	.601	.78**	.65**	.60**	.44**	(.61)		
6.Panic-agoraphobia	9	.00	1.67	.48	.375	.63**	.39**	.39**	.38**	.39**	(.64)	
7.Generalized anxiety	6	.17	2.83	1.07	.597	.80**	.48**	.51**	.50**	.47**	.29*	(.66)

*Correlation is significant at the .05 level
**Correlation is significant at the .01 level
() = cronbach's ∝ internal consistency coefficients

Descriptive statistics, reliability and intercorrelations of the stress dimensions. The internal consistency (i.e., the average correlation of items in the stress subscales) was established, to allow the researcher to gauge the scale's reliability across all seven dimensions. Cronbach's alpha internal consistency coefficients indicated adequate reliability of the individual subscales (Table 7). For the four subscales of *stress sources*, the internal consistency ranged from .56 to .87, which was higher than in Helms and Gable (1989). For the three *stress manifestations*, Cronbach's ∝ ranged from .52 to .70, which was lower than the internal consistency coefficients found by Helms and Gable (1989). The highest sources of stress were in the area of *academic self-*

concept (Mean = 2.53), with the lowest being *peer interactions* (Mean = 2.26). The highest manifestations of stress were reported for *emotional* manifestations (Mean = 2.36), and the lowest was *behavioural* manifestations (Mean = 1.87). All mean scores for the stress *sources* and *manifestations* were lower than the average of 3.00 in the range of 1.00 – 5.00. While most of the stress sources were highly positively correlated, there was more variability in the correlation between the manifestation of stress dimensions. The stress sources and manifestations were however highly associated overall (Cohen, 2013).

Table 7. *Descriptive measures, intercorrelations, and internal consistency coefficients (in parentheses) of the stress subscales (averaged Likert scores)*

Stress Variable	*n*	Descriptive				Intercorrelations									
		Min.	Max.	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Total Stress	34	1.19	3.26	2.29	.517	(.86)									
Stress sources	19	1.33	4.38	2.39	.603	.92**	(.81)								
Teacher interactions	6	1.00	5.00	2.30	.860	.74**	.81**	(.74)							
Peer interactions	6	1.17	4.50	2.26	.626	.55**	.69**	.56**	(.87)						
Academic stress	3	1.00	5.00	2.44	1.166	.79**	.78**	.47**	.35**	(.87)					
Academic self-concept	4	1.00	4.00	2.53	.720	.47**	.52**	.28*	.20	.15	(.56)				
Stress manifestations	15	1.00	3.11	2.16	.554	.83**	.56**	.44**	.19**	.58**	.26	(.62)			
Emotional	6	1.00	4.00	2.36	.771	.82**	.68**	.47*	.42**	.66**	.27	.80**	(.64)		
Behavioural	6	1.00	3.17	1.87	.616	.54**	.32*	.27*	.08	.30*	.19	.71**	.42**	(.70)	
Physiological	3	1.00	4.00	2.24	.796	.53**	.27	.24	.07	.33*	.14	.77**	.38**	.31*	(.52)

SD = standard deviation.
N = number of items of the scale.
*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

Almost all stress and anxiety dimensions were either positively correlated, or were not correlated at all (Table 8). The overall *stress* and *anxiety* correlated moderately (Cohen, 2013), as did overall anxiety with both *sources* and *manifestations* of stress (Table 8).

Table 8. *Correlations of the anxiety and stress scale scores.*

Stress variable	Anxiety	Separation anxiety	Social phobia	Obsession anxiety	Physical injury fear / anxiety	Panic / agora-phobia	General anxiety
				Anxiety variable			
Stress	.47**	.37**	.51**	.54**	.26	.16	.23
Stress sources	.38**	.32*	.44**	.38**	.21	.11	.19
Teacher interactions	.10	.13	.29*	.13	-.11	-.07	-.00
Peer interactions	.07	.08	.13	.09	-.01	.12	-.08
Academic stress	.53**	.42**	.49**	.51**	.41**	.15	.36**
Academic self-concept	.23	.16	.24	.22	.17	.12	.11
Stress manifestations	.47**	.34*	.46**	.62**	.27	.18	.22
Emotional	.39**	.29*	.33*	.48**	.32*	.06	.23
Behavioural	.20	.09	.36**	.38*	.04	.04	-.06
Physiological	.45**	.35*	.35**	.55**	.20	.28*	.29*

* Correlation is significant at the .05 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).

Distribution of Continuous Variables

Distribution of age. The distribution of age was examined, despite the sample being purposefully selected from 8-10-year-old pupils. To test for normality and lack of outliers, a Shapiro-Wilk's test was carried out (with a significant result of $p < .05$). Visual inspection of the histogram (Figure 11), normal Q-Q plots and box plot, revealed no significant outliers, showing that age was approximately equally distributed across the sample, with skewness of .100 (SE=.325) and kurtosis of -1.397(SE=.639).
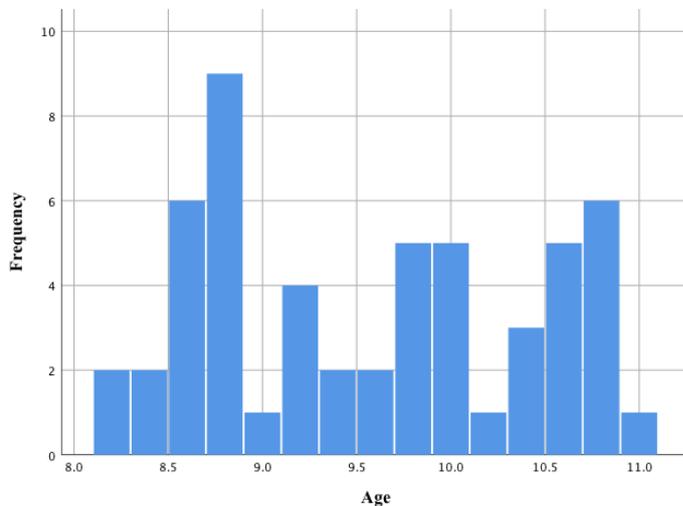
Figure 11. Distribution of age of participants.

Distribution of anxiety dimensions. Univariate normality of the six anxiety variables in the whole sample was not violated. Skewness and kurtosis values were within the recommended range (-2.00 to +2.00), according to George and Mallery (2010) for all anxiety dimensions (Table 9). Shapiro-Wilk normality statistics were significant (P<.05), except for *separation anxiety* and more marginally, *obsessive-compulsive* anxiety. However, histograms indicate distributions that are close to normal and Q-Q plots indicated close to normal linearity (see Appendix R). Boxplots revealed an outlier in *panic-agoraphobia* (*participant ID* = 10) and two outliers in *physical injury fears* (*participant ID* = 6, 34)[Appendix S]. As the sample size was small, and outliers had scored on the variables within the range of 0.00 – 3, these participants were kept in the study for further analysis.

Table 9. *Normality measures of anxiety dimensions and normality test significance.*

Anxiety dimensions	Normality measure	Statistic	Std.error	Shapiro-Wilk *p*-value
Separation anxiety	*Skewness*	.147	.325	.243
	Kurtosis	-.523	.639	
Social Phobia	*Skewness*	.491	.325	.020
	Kurtosis	-.294	.639	
Obsessive-compulsive	*Skewness*	.356	.325	.052
	Kurtosis	-.718	.639	
Physical injury fears	*Skewness*	.676	.325	.015
	Kutosis	1.080	.639	
Panic-agoraphobia	*Skewness*	.886	.325	.005
	Kurtosis	.757	.639	
Generalised anxiety	*Skewness*	.678	.325	.031
	Kurtosis	.340	.639	

The assumption of a linear relationship among dependent variables *separation anxiety, social phobia, obsessive-compulsive, physical injury fears, panic-agoraphobia and generalised anxiety* was met for each of variables at each level of reading group, according to scatterplot matrices (Appendix T).

Distribution of stress source dimensions. Univariate normality of the four stress sources across the whole sample was not fully violated (see Appendix U for histograms). Skewness and kurtosis values were within, or close to, the recommended range (-2.00 to +2.00) for all sources of stress dimension except for *peer interactions* (Table 10). When examining the Q-Q plots there was an adequate fit with normal

distribution (i.e., most of the points lie close to the line), yet the box plot revealed two outliers for *peer interactions* (Participant ID = 30, 31); both of whom were in the *no significant reading difficulties* group (see Appendix U). While Shapiro-Wilk normality statistics were significant (P<.05), for all dimensions except *academic self-concept* (Table 10), the Q-Q plot for *academic self-concept* revealed a relatively good fit for normal distribution, with all points close to the line (Appendix U). As the sample size was small, and the outliers all had scores within the range of 1.00 – 5.00, these participants were kept in the study for further analysis.

Table 10. *Normality measures of Sources of Stress dimensions and normality test significance.*

Stress sources	Normality measure	statistic	Std.error	Standardised	Shapiro-Wilk p-value
Teacher Interactions	*Skewness*	.864	.325	2.66	.018
	Kurtosis	.950	.639	1.49	
Peer Interactions	*Skewness*	1.350	.325	4.15	.000
	Kurtosis	3.200	.639	5.00	
Academic stress	*Skewness*	.373	.325	1.17	.003
	Kurtosis	-1.009	.639	-1.58	
Academic self-concept	*Skewness*	-.238	.325	-0.73	.161
	Kurtosis	-.461	.639	-0.72	

N=54

Distribution of stress manifestations dimensions. Univariate normality of the three stress manifestations in the sample was met. *Skewness* and *kurtosis* values were within the recommended range (-2.00 to +2.00) for all three stress manifestations (Table 11). Shapiro-Wilk normality statistics were significant (P<.05) for *behavioural* and *physiological*, but not for *emotional* manifestations (Table 11). There were no outliers within any of the stress manifestations (Appendix V), and the variable of *emotional* manifestations is viewed as approximately normally distributed, as were all stress manifestation dimensions, from examination of the histogram distributions and Q-Q plots for these dimensions (Appendix V).

Table 11. *Normality measures of Manifestations of Stress dimensions and normality test significance.*

Stress Manifestations	Normality measure	Statistic	Std.error	Standardised	Shapiro-Wilk *p*-value
Emotional	*Skewness*	.016	.325	.049	.284
	Kurtosis	-.658	.639	-1.03	
Behavioural	*Skewness*	.249	.325	.766	.020
	Kurtosis	-.652	.639	-1.02	
Physiological	*Skewness*	.26	.325	0.8	.042
	Kurtosis	-.693	.639	-1.57	

N=54

Testing the Assumptions prior to Statistical Analysis

Three one-way multivariate analyses of variance (MANOVAs) were run, as *omnibus* statistics, to determine if there was any significant effect of group on the six anxiety dimensions; four source of stress dimensions; and three manifestation of stress dimensions. Follow up ANOVAs, and t-test analyses were then carried out to establish the specific groups that differed significantly on the subscale scores. However, before running the MANOVAs and t-tests, certain assumptions had to be met.

Rigorous preliminary checking was carried out to ensure that key assumptions (Appendix W) were met, prior to running each statistical test. While this checking is seen as essential information to be provided alongside statistical tests, it is considered to detract from the key findings being reported. Therefore, for completeness, results from this testing are included in Statistical Appendices (Appendices X, Y & Z). Importantly, as a result of this checking, both MANOVA and t-tests were deemed appropriate tests to be utilised in relation to both the study design and the data collected.

Effect of Group on Anxiety Dimensions

Research question two: Do children with a D-TP experience greater anxiety than their peers? The null hypothesis states that there would be no statistically significant difference in levels of anxiety between the D-TP group and the peer groups in any one of the anxiety dimensions. *The alternate hypothesis states that children with a D-TP will experience higher levels of anxiety in one or more anxiety dimension than their peers.*

The descriptive measures of the six anxiety dimensions for each of the three reading groups are displayed in Table 12. With regards to anxiety sub-scale scores, the minimum is 0, and the maximum is 3.

Table 12. *Descriptive measures of anxiety dimension scores for each reading group.*

| | Reading Group | | | | | | | |
| | Total $n =54$ | | D-TP $n =6$ | | Generic poor readers $n =14$ | | No significant reading difficulties $n =34$ | |
Anxiety Dimension	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Separation	.97	.555	1.19	.695	.70	.531	1.03	.517
Social Phobia	.93	.680	1.53	1.067	.66	.662	.93	.549
Obsessive-compulsive	.84	.563	1.33	.587	.70	.544	.81	.536
Physical injury fear	.94	.601	1.10	.945	.76	.409	.99	.598
Panic-agoraphobia	.48	.375	.56	.233	.45	.507	.48	.338
Generalised anxiety	1.07	.597	1.53	.799	.69	.502	1.15	.520

N=54

Multivariate analysis of variance (MANOVA) results. A one-way MANOVA was conducted to test if there were any between-group differences in anxiety dimension scores. According to the results of the multivariate tests, when interpreting Pillai's Trace, there was no effect of the reading group on the linear combination of the six anxiety dimensions; Pillai's trace = .32. Pillai's trace is a test statistic used in multivariate analysis of variance, which provides a positive valued statistic ranging from 0 to 1. Larger values mean that effects are contributing more to the model, and one should reject the null hypothesis. The multivariate effect size was estimated by Pillai's Trace to be at .32, which implies that 32% of the variance was accounted for by group [F(12, 94) = 1.49, p = .14, partial η^2=.16]. However, because the degrees of freedom is greater than one, Pillai's tends to be less powerful, and Roy's Maximum Root (a test statistic that gives an upper-bound for the F statistic), is thought to be the better option to identify effect (Seber, 1984). Upon examining the output from Roy's Maximum Root, the interaction between group and anxiety dimensions was significant (Roy's largest root =.295, F(6, 47)=2.309,p<0.05), meaning that we can reject the null

hypothesis and conclude that the three groups differ significantly somewhere across one or more of the anxiety dimensions.

As the multivariate effect was significant, the next step was to interpret the results of tests for between-group effects. For that purpose, Bonferroni correction for the six independent variables was used; whereby the common significance level (p <.05) was divided by the number of dependent variables (six), so that the new threshold was set to p < .008. Due to unequal variances displayed for *social phobia*, the significance threshold was set to < .004. The results of the univariate tests of between-subjects effects of the independent variable reading group are displayed in Table 13. The only significant effect of reading group was for *generalised anxiety* (in bold) (p = .006, < .008). This tells us that there is a significant difference in generalised anxiety between two groups, but which two groups is still unclear, from this test.

Table 13. *Results of the tests of between-subject effects of reading group.*

Anxiety Dimension	Sum of Squares	df	Mean Square	*F*	*p*	Partial η^2
Separation	1.445	2	.722	*2.471*	*.095*	*.088*
Social Phobia	3.202	2	1.602	*3.830*	*.028*	*.131*
Obsessive-compulsive	1.749	2	.874	*2.962*	*.061*	*.104*
Physical injury fears	.720	2	.360	*.996*	*.376*	*.038*
Panic-agoraphobia	.045	2	.022	*.154*	*.857*	*.006*
Generalised anxiety	3.476	2	1.738	*5.759*	***.006***	*.184*

F = F-statistic associated with p value
df = degrees of freedom

The next step was to identify which groups differed significantly on *generalised anxiety*. According to the multiple comparisons, with Bonferroni adjustment, the only significant difference in *generalised anxiety* was between D-TP and generic poor reading group (*Mean Difference[MD] =*.84, *p =*.008, 95% CI [.19, 1.48]). There was no difference between *D-TP* readers and the group with no significant reading difficulties (*MD =*.38, *p=*.27, 95% [-.21, .97]), nor between the generic poor reading group and the group with no significant reading difficulties (*MD =*.46, *p=*.031, 95%[-.88, -.04]).

Due to the lack of statistical power that accompanies a small sample size and the increased risk of a type II error (i.e., retaining the null hypothesis in relation to further anxiety dimensions) while carrying out multivariate analysis, a second round of statistical analysis was carried out. Independent-sample t-tests were run to analyze differences between the D-TP group and the two peer groups, on mean anxiety subscale scores. Before analyzing the data with t-tests, checking was carried to ensure that certain assumptions were met (see Appendices W& X).

T-test analysis results. The results of the t-test analyses (Tables 14 & 15) were concurrent with the multivariate analysis finding: the D-TP group displaying greater *generalised anxiety* (*M*=1.53, *SD*=.799) in comparison to the generic poor readers (*M*=.69, *SD* =.502); a statistically significant difference, *MD* = .84, 95% CI[.22, 1.45], *t*(18) = 2.864, *p* = .01, *d* = 1.26). Also, there was no significant difference in *generalised anxiety* when the D-TP group was compared to the group with no significant reading difficulties (*M*= 1.15, *SD* = .520). In addition to the previous round of analysis, the D-TP group was found to report significantly greater levels of anxiety than their peer groups in two further dimensions.

Table 14. *Descriptive statistics and t-test results of anxiety scores between the D-TP and the generic poor reading group.*

	Reading Group				95% CI for Mean Difference	t	df
	D-TP n =6		Generic poor readers n =14				
Anxiety Dimension	Mean	SD	Mean	SD			
Separation	1.19	.695	.70	.531	-.104, 1.088	1.734	18
Social Phobia	1.53	1.067	.66	.662	.058, 1.688	2.250*	18
Obsessive-compulsive	1.33	.587	.70	.544	.061, 1.201	2.325*	18
Physical injury fear	1.10	.945	.76	.409	-.280, .965	1.157	18
Panic-agoraphobia	.56	.233	.45	.507	-.356, .563	.472	18
Generalised anxiety	1.53	.799	.69	.502	.223, 1.451	2.864*	18

*p< .05

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Table 15. *Descriptive statistics and t-test results for the anxiety scores between the D-TP and the group with no significant reading difficulties.*

	Reading Group				95% CI for		
	D-TP		No significant				
	$n =6$		reading difficulties		Mean	t	df
			$n =34$		Difference		
Anxiety Dimension	Mean	SD	Mean	SD			
Separation	1.19	.695	1.03	.517	-.327, .648	.665	38
Social Phobia	1.53	1.067	.93	.549	-.519, 1.712	1.339	5.477
Obsessive-compulsive	1.33	.587	.81	.536	.033, 1.007	2.161*	38
Physical injury fear	1.10	.945	.99	.598	-.481, .692	.366	38
Panic-agoraphobia	.56	.233	.48	.338	-.221, .364	.498	38
Generalised anxiety	1.53	.799	1.15	.520	-.126, .887	1.522	38

*p< .05

The D-TP group reported greater *social phobia anxiety* (*M*=1.53, *SD*=1.067) than the generic poor reading group (*M*= 0.66, *SD*=.662), a statistically significant difference, *MD* =.87, 95% CI [.06, 1.69], *t*(18) = 2.250, *p* = 0.037, *d* = 0.98). The D-TP group reported greater *social phobia anxiety* than the students with no significant reading difficulties (*M*=.93, *SD*=.549), but this was not a significant finding, as a result of having to calculate this difference with separate variances. The D-TP group reported greater *obsessive-compulsive anxiety* (*M*= 1.33, *SD* =.587) than the students with no significant reading difficulties (*M*= .99, SD= .598), a statistically significant difference, *MD* = .52, 95% CI[.03, 1.00], *t*(38) = 2.161, *p* = 0.037, *d* = 0.92). The D-TP group also reported greater *obsessive-compulsive anxiety* than the generic poor readers (M=.70, SD = .544), a statistically significant difference, *MD* =.63, 95% CI[.06, 1.2], *t* (18) = 2.325, *p* =.032, *d* = 1.16.

Effect of Group on School-Related Sources of Stress

Research Question Three: Do children with a D-TP experience greater school-related sources of stress than their peers? The null hypothesis states that there would be no statistically significant difference in levels of anxiety between the D-TP group and the peer groups in any of the source of stress dimensions. The alternate hypothesis is that children with a D-TP will experience higher levels of stress in one or more source of stress dimension than their peers.

The descriptive measures of the four school-related stress-source dimensions for each of the three reading groups are displayed in Table 16. With regards to these sub-scale scores, the minimum is 1, and the maximum is 5.

Table 16. *Descriptive analysis of stress-source scores for each group.*

| | Reading Group | | | | | | | |
| | Total $n =54$ | | D-TP $n =6$ | | Generic poor reader $n =14$ | | No significant reading difficulties $n =34$ | |
Stress source subscale	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Teacher Interactions	2.31	.860	2.44	.647	2.08	.808	2.37	.916
Peer Interactions	2.26	.626	2.28	.228	2.27	.368	2.25	.754
Academic	2.48	1.161	2.78	1.530	2.26	1.141	2.51	1.123
Academic Self Concept	2.53	.720	3.21	.485	2.41	.869	2.46	.637

Results of the multivariate analysis of variance (MANOVA). A one-way MANOVA was conducted as an omnibus test, to determine if there was any effect of group on the four stress source dimensions. This test was deemed appropriate, following preliminary assumption checking (Appendices W & Y). According to the results of the multivariate test, there was no effect of reading group on the linear combination of the four stress sources; Pillai's Trace = .16, $F(8, 98) = 1.05$, $p = .40$, partial $\eta^2=.08$. Therefore, it appears that students with a D-TP had greater mean scores than generic poor readers and proficient readers on all four sources of stress scales (i.e., teacher interactions, peer interactions, academic stress and academic self-concept), but not significantly so, according to the multivariate analysis. However, due to the lack of statistical power that accompanies a small sample size and the increased risk of a type II error (i.e., retaining the null hypothesis in relation to further anxiety dimensions) while carrying out multivariate analysis, the second round of statistical analysis was carried out.

T-test analysis results. Independent-sample t-tests were run to analyze differences between groups; specifically, the difference between the D-TP and the generic poor reading group (Table 17); and the D-TP group and the group with no significant reading difficulties (Table 18) on mean stress-source subscale scores. Before

running this analysis, it was important to check that certain assumptions were met concerning analyzing the data with t-tests (see Appendices W&Y).

Table 17. *Results of t-tests and descriptive statistics for stress-source scores, for pupils with a D-TP and generic poor readers.*

Stress source subscale	D-TP n =6 Mean	SD	Generic poor reader n =14 Mean	SD	95%CI for Mean Difference	t	df
Teacher Interactions	2.44	.647	2.08	.808	-.425, 1.14	.965	18
Peer Interactions	2.28	.228	2.27	.368	-.339, .347	.024	18
Academic	2.78	1.53	2.26	1.141	-.777, 1.809	.838	18
Academic Self Concept	3.21	.485	2.41	.869	-.004, 1.600	2.091*	18

*p = .051

Table 18. *Results of t-tests and descriptive statistics for stress source scores for pupils with a D-TP and students with no significant reading difficulties.*

Stress source subscale	D-TP n =6 Mean	SD	No significant reading difficulties n =34 Mean	SD	95% CI for Mean Difference	t	df
Teacher Interactions	2.44	.647	2.37	.916	-.721, .865	.183	38
Peer Interactions	2.28	.228	2.25	.754	-.606, .662	.089	38
Academic	2.78	1.53	2.51	1.123	-.794, 1.330	.511	38
Academic Self Concept	3.21	.485	2.46	.637	.190, 1.3	2.71*	38

*p < .05

This round of analysis revealed that the D-TP group reported greater stress in relation to academic self-concept stress (M = 3.21, SD=.485), than the group with no significant reading difficulties (M =2.46, SD=.637), a statistically significant finding, MD = .745, 95%[.19, 1.26], t(38) = 2.718, p = .01, d= 1.33. The D-TP group was also found to report greater levels of academic self-concept stress than the generic poor reader group (M=2.41, SD =.869), although this difference just missed significance levels MD = .797, 95% [.152, 1.44], t(18) = 2.091, p = .051, d = 1.14 .

In summary, the results show that the D-TP students reported greater stress than both of the peer groups in relation to all source of stress subscales (Table 16). However, the only significant difference to be found was between the D-TP students and the students with no significant reading difficulties, where the D-TP group reported significantly higher *academic self-concept* stress. The D-TP group did not differ significantly from the two peer groups in teacher interactions, peer interaction or academic stress.

Effect of Group on Manifestations of Stress.

Research question four: Do children with a D-TP experience greater school-related manifestations of stress that their peers? The null hypothesis states that there would be no statistically significant difference in levels of anxiety between the D-TP group and the peer groups in any of the stress manifestation dimensions. The alternate hypothesis is that children with a D-TP will experience higher levels of stress in one or more manifestation of stress dimension than their peers.

The descriptive results for the reported manifestations of stress dimension for each of the three reading groups are displayed in Table 19. With regards to these sub-scale scores, the minimum is 1, and the maximum is 5.

Table 19. *Descriptive statistics of stress manifestation scores for each dimension and group.*

	Reading Group							
	Total $n =54$		D-TP $n =6$		Generic poor readers $n =14$		No significant reading difficulties $n =34$	
Stress Manifestation	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Emotional	2.36	.771	2.14	.778	2.16	.938	2.48	.691
Behavioural	1.87	.616	2.03	.627	1.88	.696	1.84	.595
Physiological	2.25	.796	2.89	.689	1.79	.758	2.32	.741

SD, standard deviation

Multivariate analysis of variance (MANOVA) results. Following relevant assumption checking (Appendices W& Z), a one-way multivariate analysis of variance (MANOVA) was conducted to test the hypothesis that there would be one or more

mean difference between group and stress manifestation scores. According to the results of multivariate tests, there was a significant effect of reading group on the combination of the stress manifestations; Pillai's Trace = .26, $F(6,100)$ = 2.45, p = .03, partial η^2=.13. Therefore, children in the three groups (D-TP, poor reader and no significant reading difficulties) did differ in the reported levels of stress manifestations (i.e., emotional, behavioural and physiological).

With a significant multivariate effect being apparent, the next step was to interpret the results of tests of between-subject effects (Table 20). Bonferroni correction for the three dependent variables was used for this purpose. In other words, the common significance level (p=.05) was divided by the number of dependent variables, to form a new threshold of p = .016. No significant effect of *reading group* on *emotional* stress manifestations was found [$F(2,51)$ = 1.10, p = .34, partial η^2=.042]. No significant effect of *reading group* on *behavioural* stress manifestations was found [$F(2,51)$ =.22, p =.80, partial η^2=.009]. However, the three *reading groups* differed significantly on *physiological* manifestations, [$F(2,51)$ =5.65 p =.009, partial η^2=.168].

Table 20. *Results of the t-test of between-subject effects of reading group on stress manifestations.*

Stress Manifestation	Sum of Squares	df	Mean Square	*F*	*p*	Partial η^2
Emotional	1.309	2	.655	*1.104*	*.339*	*.042*
Behavioural	.175	2	.087	*.224*	*.800*	*.009*
Physiological	5.650	2	2.825	*5.156*	***.009***	*.168*

F = F-statistic associated with p value
df = degrees of freedom

According to the multiple comparisons with Bonferroni adjustment, the only significant difference in *physiological* stress manifestations was between the D-TP group and the generic poor readers (MD = 1.10 ,p= .01, 95% CI[.21, 1.9]). There were no significant differences between D-TP and the no significant reading difficulties group (MD = . 57, p=.27, 95% CI[-.25,1.38]), nor between the generic poor readers and the readers with no significant reading difficulties (MD = -.54, p= .08, 95 % CI[-1.1, .44]).

Summary of Findings

In summary, a prevalence figure of 11% was found for a D-TP in this sample. Second, readers with an identified D-TP reported higher anxiety in three of the anxiety dimensions, when compared with two different peer groups. The D-TP group reported higher *generalised anxiety, social-phobia anxiety* and *obsessive-compulsive anxiety* than the generic poor readers. Also, readers with an identified *D-TP* reported higher *obsessive-compulsive anxiety* than the group with no significant reading difficulties. The D-TP group did not differ significantly from the two peer groups in the remaining three anxiety dimensions. Third, the results show that the D-TP students reported greater stress than both of the peer groups in relation to *teacher interactions, peer interactions* and *academic stress*, but the only difference that reached significance was between the D-TP group and the group with no significant reading difficulties, where the *D-TP* group reported higher *academic self-concept.* Finally, students with a dyslexic-type profile reported higher *physiological* stress manifestations than generic poor readers, but did not differ in reported *emotional* or *behavioural* manifestations of stress.

Chapter Five: Discussion

The purpose of this correlational study was first, to investigate the prevalence of a dyslexic-type profile (D-TP) in an 8-10-year-old student cohort, using an operationalised definition based on the *Simple View of Reading* (SVR). Secondly, the study aimed to investigate levels of self-reported anxiety and school-related stress across multiple dimensions, for students identified with a D-TP, when compared to generic poor readers (i.e., students with below-average reading comprehension and below-average listening comprehension) and students with no significant reading difficulties. This discussion will integrate this study's findings with a research-based understanding and relevant literature.

Prevalence of a Dyslexic-Type Profile

This study found the prevalence of a D-TP to be 11%, which falls within the range of 5-15% proposed by the Diagnostic and Statistical Manual of Mental Disorders (5th edition.; DSM-V; American Psychiatric Association [APA], 2013), for dyslexia, and within the range of 3-17% identified in epidemiological studies (Table 2). It is, however, difficult to compare the prevalence rate in this study with those figures previously reported in the literature for New Zealand (Rutter et al., 2004) and elsewhere, due to differing definitions, methodologies and criteria. Nevertheless, given that the methodology in this study utilised a Low Achievement Method (LAM) and associated cut-off points for two out of three criteria, there was value in comparing the rate found in this study with rates reported in epidemiological studies' that utilised a similar LAM approach.

The methodology for identifying a dyslexic profile in this study will possibly have underestimated prevalence, in comparison to other LAM studies, specifically as a result of the adopted cut-off point and the additional criteria of above-average listening comprehension. While there appears to be heterogeneity between the prevalence findings in this study and those reported in studies with similar methodology, the cut-off points differ in a way that is suggested to make this prevalence finding meaningful. This study's prevalence rate off 11% (utilising a 2 SDs below the mean cut-off) was remarkably similar to the prevalence of 10% found by a study using 1.5 SD cut-off (Stothard et al., 2013) and the prevalence rate of 12% observed with a .67 SD cut-off

(Katusic et al., 2001). This study's 2 SD cut-off point would be expected to reveal a much lower prevalence rate than a 1.5 SD cut-off point, when, in fact, the opposite is true. Additionally, when Stothard et al., (2013) did adopt a cut-off point identical to this study, their comparative prevalence rate finding was only 3%. According to Snowling (2013), the cut-off point of 2 SDs below the mean, should reveal a prevalence rate for moderate to severe dyslexia, whereas 1.5 SD is likely to represent mild to moderate dyslexia. Overall, the prevalence rate of 11% found in this study was somewhat larger than expected, especially for moderate to severe dyslexia, when compared to previous studies and based on an understanding of the continuous nature of reading skill distribution. Two possible explanations may be considered for this finding.

First, the age range or developmental stage of the sample may play a role in the elevated prevalence rates, when compared to other studies adopting cut-off points closer to the mean and wider age-ranges, which reach well into adolescence (i.e., Katusic et al., 2001; Stothard et al., 2013). Further evidence for this possibility comes from the somewhat elevated prevalence rate of 15.2% identified for the same age-range of 8-10-year-olds in the Rutter et al., (2004) study. However, given the cut-off point (close to 1 SD below the mean) adopted by Rutter et al., one would expect their study to demonstrate a higher prevalence rate. The possibility still exists that a greater prevalence rate is evident in 8-10-year-olds when compared with a broader age range such as 6-16-year-olds (Stothard et al., 2013) or 5-19-year-olds (Katusic et al., 2001). These results highlight the need for further cross-sectional research, comparing the prevalence of various age-bands within New Zealand, to elevate these statements beyond possibility towards probability.

The second possibility is that something specific to New Zealand results in a higher prevalence rate for a D-TP, as demonstrated by Rutter et al., (2004), and when compared to research in the UK (Stothard et al., 2013) and the USA (Katusic et al., 2001). Considering New Zealand's trailing tail of low achievement in literacy (Chamberlain & Caygill, 2013), it is reasonable to expect that a low achievement diagnostic criteria in New Zealand might result in a comparatively elevated prevalence rate, as demonstrated in this study. However, this study included the criteria of above-average listening comprehension, identifying discrepant achievement rather than general low ability in comprehension or poor reading comprehension alone. Therefore,

the approach to reading instruction in New Zealand should be considered. The prevalent whole language approach, and the absence of systematic and explicit phonics instruction has received targeted criticism in New Zealand for being an inadequate approach to reading instruction (Tunmer, Chapman, Greaney, Prochnow & Arrow, 2013; Tunmer & Chapman, 2015). A lack of phonics instruction is likely to result in enduring specific word-level decoding difficulties for some children and inflated prevalence rates for a D-TP. This is in contrast to countries where an instructional environment that is rich in phonics would likely alleviate the specific word-level decoding difficulties associated with dyslexia. Indeed, all six students in this study, initially identified as discrepant comprehenders, also displayed a skill deficit in word-level decoding. Larger-scale longitudinal research examining prevalence in relation to literacy instruction (e.g., whole language, phonics or mixed approach), would allow for further certainty around such speculations.

Within the D-TP group, a gender ratio was identified, of two boys to one girl. These results are in line with studies revealing a male gender bias in dyslexia (Katusic et al., 2001; Rutter et al., 2004; Shaywitz et al., 1990). However, this sample did not reveal a statistically significant gender difference, possibly due to sample size. Larger scale studies would be required to confirm whether this gender ratio is significant, as suggested in the aforementioned studies.

Overall, the findings in relation to this first research question demonstrate the usefulness of an SVR operationalised definition of dyslexia for New Zealand to begin the preliminary identification of a D-TP. The findings tentatively suggest that it is possible to utilise the SVR, within the New Zealand classroom, as a framework to help identify individuals and groups of individuals with a distinct profile of component reading abilities, that reflect a D-TP of unexpected underachievement and poor phonological processing skills. In other words, this method may act as a preliminary teacher-administered assessment for a dyslexic-type profile of abilities. Therefore, the study provides some initial support for the SVR to be used in New Zealand, to support new national policy (i.e., the Learning Support Action Plan, MoE [2019]), to screen for dyslexia, with this age group.

Lastly, this study highlights the relevance of having data on prevalence. While further research using the operationalised SVR is needed within New Zealand and

abroad, to confirm and compare the prevalence figure identified in this study, it appears that New Zealand has an elevated prevalence rate. Drawing on previous propositions in the literature (Tunmer & Chapman, 2015; Tunmer et al., 2013), it is a possibility that this dyslexic-type profile, which focuses on the reading symptomology of dyslexia, would not manifest as elevated, in a context of adequate instruction. This is not to say that dyslexia is caused by poor reading. Rather, the suggestion is that the lesser focus on systematic and explicit word-level decoding in reading instruction in New Zealand, allows this specific reading-skill deficit to be an enduring one for some students, made more challenging to overcome in the absence of explicit appropriate instruction.

Dyslexic-Type Profile and Anxiety

The findings were consistent with the researcher's hypothesis that children with a D-TP would experience greater anxiety in one or more dimension than their peers. Across all measured dimensions of anxiety, the D-TP group displayed greater anxiety than the generic poor reading group and proficient readers, although these group-differences were not all significant. The key significant finding in relation to this hypothesis was the D-TP group reporting significantly greater *Generalised Anxiety* (GA) than the generic poor reading group. This first round of analysis revealed no other significant differences between any group across the remaining five dimensions of anxiety (*separation, social-phobia, obsessive-compulsive, physical fears,* and *panic-agoraphobia*). However, findings from the second round of analysis indicated that students with a D-TP reported greater levels of anxiety in two further dimensions, compared to students with no significant reading difficulties: *social-phobia* and *obsessive-compulsive* anxiety. Similarly, when compared to generic poor readers, students with a D-TP reported significantly greater anxiety in the *social phobia* dimension.

The finding in relation to the D-TP groups having elevated *generalised anxiety* (GA) is consistent with the few studies that examined dimension of anxiety, rather than anxiety as a single construct (i.e., Carroll, 2005; Mammarrella, 2016; Novita, 2016; Willcutt et al., 2013). A similar finding in relation to *social phobia* anxiety was identified by Mammerella (2016), with a clinic-referred sample, whereas the *obsessive-compulsive* anxiety results appear to be a novel finding. *Social* anxiety may emerge as secondary anxiety. As proposed by Mammarella et al., (2016), students with dyslexia

may expect to perform poorly, and negative expectations and general anxiety may lead to social anxiety as a result of peer comparisons and negative interactions with peers, teachers and, or parents.

With regards to anxiety in the obsessive-compulsive dimension, the DSM-V (APA, 2013; Appendix B) guides us to understand that this behaviour should be conceptualised as a way of coping in order to avoid situations that may be anxiety-inducing. The lack of prior, concurrent evidence for this tentative association between elevated anxiety in the obsessive-compulsive dimension and dyslexia may be due to the limited number of studies examining dimensional aspects of anxiety with dyslexia. While there is no identified evidence in the literature to corroborate this finding, the result links well with a study by Sobin, Blundell and Karayiorgou (2000), who found 32% of a sample of children with an Obsessive-Compulsive Disorder diagnosis had correlating learning disabilities. From a social cognitive perspective, an individual's locus of control may serve as a key protective factor. However, when controllability is appraised by an individual to be lacking, as theorised by Lazarus and Folkman (1984), one can envisage a pathway to excessive anxiety in this domain, when school feels so distressing, that these students may try to counter this feeling by exerting some control themselves. Nevertheless, this suggestion would need further research to strengthen this tentative finding and qualitative studies to confirm the speculative link.

While the direction of causality cannot be inferred, due to this being a correlation study, speculations regarding *generalised anxiety* and distinguishing features of the D-TP group can be made. The D-TP group was identified as underachieving in reading comprehension in relation to listening comprehension. It is possible, from a social cognitive and cognitive perspective, that elevated generalised anxiety in the D-TP group may arise from an implicit awareness of their discrepancy in ability between spoken and written language. Past experiences perhaps prime these students for more arousal around literacy-based activities, and school in general. Following this priming effect, and in the absence of decoding skills, individuals with this discrepancy (the D-TP group) have no means available to control the arousal, which, according to Mandler (1984) leads to feelings of helplessness and anxiety. The generic poor readers, as identified in this study, display no discrepancy between their listening comprehension and reading comprehension. It is possible that the generic poor readers' emotional

perception of their difficulties may not prime them for anxiety in the same way as is suggested for the D-TP students. However, quantitative findings only speak to correlations; they do not provide the individual experience, emotional perception or social context of the participants.

The large effect sizes associated with significant results demonstrate the strength of the significant differences in anxiety experienced by the D-TP group when compared with proficient readers (E = .56, for *generalised anxiety*; E = .98, for *social anxiety*, and E = 1.16, for *obsessive-compulsive anxiety*) and when compared with generic poor readers (E = 1.26, for *generalised anxiety*; E = .71 for *social anxiety*). The effect size for the difference in *generalised anxiety* reported by the dyslexic group in comparison to the generic poor readers (E=1.26) was also large in comparison to effect sizes reported in similar studies (Table 3: Novita, 2016; E = 0.42; Willcutt, 2013, E = 0.36; Carroll et al,., 2005, E = 0.69), with the exception of the Italian study (Mammarella et al., 2016; E = 1.42). Furthermore, the relatively large effect sizes attached to these differences were gained while utilising self-reports, which have been demonstrated to be a conservative source of information within similar studies (Dahle et al., 2011; Heiervang et al., 2001) and when compared to a study utilising parent and teacher reports (i.e., Willcutt, 2013). Again, replication of this study, with reports from teachers, parents and students, would confirm whether or not, as in previous studies, the student reports are indeed conservative and in turn, whether or not the effect sizes are perhaps underestimated.

Speculative conclusions can be drawn when comparing the effect sizes of the differences in anxiety experienced by the D-TP in this study, with other studies. One possible reason for this study's relatively large effect sizes is that comparable studies adopted a broader age range. There is some suggestion in the literature that emotional correlates of dyslexia may dissipate over time (Burden, 2005), which would account for the smaller effect size in some studies, such as Willcutt et al., (2013), and Carroll et al., (2005), and a lack of significant difference identified in other studies (Miller, 2005); all of which utilised age ranges that extend toward late adolescence. A second possible reason for the larger effect sizes relates to context. In New Zealand, the whole language approach to literacy instruction and the associated deficit in word-level decoding instruction potentially reduces the D-TP group's experience of control, which in turn can lead to feelings of helplessness, regarding their reading progress. Alternatively, but

with a similar contextual lens, the larger effect sizes within this study and the Mammarella et al., (2016) study may be due to the lack of recognition, and teacher awareness, of dyslexia in both New Zealand and Italy. Recent research (Barbiero et al., 2019) points to a lack of recognition of dyslexia in Italy. While New Zealand educators are similarly still grappling with how to identify and address dyslexia and our education system is still evolving in its understanding of dyslexia (Elias, 2014; Hawkings, 2004; MoE, 2019). It is important to explore this finding in more detail, based on an understanding of pedagogical approaches to literacy and theoretical understanding of learning, cognition and attributions.

This study identified elevated GA in students with a D-TP that is greater than that reported in countries where dyslexia has been acknowledged for a longer time (i.e., United States of America: Willcutt [2013], and the United Kingdom: Carroll [2005]). It is interesting to note that the instructional practice of delivering systematic phonics-based instruction has been a mandatory part of the National Curriculum in England for over ten years (Department of Education, 2006). In the absence of such government-mandated practice in New Zealand, students with a D-TP, who are ill-equipped to decode at the word-level, could have been subjected to multiple and repeated reading-related anxiety-inducing situations throughout their schooling. The D-TP group may, therefore, attribute their anxiety more strongly and generally to regular feelings of helplessness. Alternatively, generalised anxiety items may be highly reported, as there is a lack of specificity in the measurement tool, to account for specific scholastic domains of anxiety. Further research measuring scholastic domains of anxiety may contribute to our understanding of the specificity of school-related anxiety within the generalised anxiety experienced by this group of D-TP students.

In summary, the findings in this study in relation to the D-TP group reporting greater *generalised anxiety* to other readers is consistent with other international studies but differs in contrasting the generalised anxiety of the D-TP group with *generic poor readers*, as a comparison group. The elevated *generalised anxiety* has possibly emerged as a result of negative self-evaluation, priming effect and a lack of controllability, from a social cognitive and cognitive perspective. However, the finding that relates to the DT-P group experiencing greater anxiety in the *obsessive-compulsive* dimension was novel in the context of the literature and discussed in terms of social cognition theory,

as potentially emerging in response to reduced controllability in the school context. Whereas, the finding related to the D-TP having elevated anxiety in the *social* dimension is common to only one identified study (Barbiero et al., 2019), carried out in Italy. It is suggested, that the Italian context, is similar to New Zealand with regards to its understanding and identification of dyslexia and that this common finding in relation to social anxiety may also be linked to levels of awareness of dyslexia in the educational context. Speculations have been made regarding the relatively large effect sizes associated with these findings, framed in the context of the literature and in relation to the New Zealand context.

Dyslexic-Type Profile and School-Related Stress Sources.

It was hypothesised that children identified with a D-TP would experience greater stress in one or more dimension of school-related stress source than their peers. The dyslexic type profile group did indeed demonstrate that they experience significantly greater stress in one scale by reporting greater *academic self-concept* stress when compared to proficient readers and the generic group, although the latter finding was just below significance levels. The key finding that the D-TP group experience more *academic self-concept* stress than the proficient reading group, allows us to reject the null hypothesis that there would be no greater stress experienced by the D-TP group in any stress source dimension.

Elevated *academic self-concept* stress reported by students with a dyslexic profile is concurrent with findings in this specific scale reported by Alexander-Passe (2008). He suggested that this finding, combined with underachievement is partly attributable to the culture of standardised testing in the UK, which, by the very nature of the assessment method, involves individuals being compared against population norms. In comparison to Helms' (1996) findings, the direction of group differences (i.e., the pattern of reported findings in relation to school-related sources of stress between the D-TP group and comparison groups) are mostly consistent. In New Zealand, there has been a rise in accountability pressures within schools, accompanied by standardised testing (Crooks, 2011). Despite National Standards being abolished by the current Labour Government, it is possible that the rhetoric of students being *above, at, below, or, well below* still exists within primary schools.

Speculation can be made, based on the transactional stress theory (Lazarus & Folkman, 1984), that students from the D-TP group may feel the discrepancy in comparison to proficient reading peers, as well as in their performance (where they achieve success in one area but a distinct lack of controllability in another). The classroom-based assessment tools utilised within this study, for example, are regularly administered standardised measures, the results of which are often reported back to students and parents as stanine results: direct comparisons with population norms. Overall, it is suggested that stress could feasibly arise in relation to peers or self, as the individuals may negatively assess their coping resources, or ability to improve the situation in this dimension of academic self-concept.

Dyslexic-Type Profile and School-Related Manifestations of Stress.

Three reading groups were examined in relation to emotional, physiological and behavioural manifestations of school-related stress. The null hypothesis is rejected, as the D-TP group were found to show significantly greater *physiological* stress manifestations than the generic poor reading group. Physiological manifestations of stress is a physical response to stress that may manifest as tremors, nausea or a rapid heart rate (Helms & Gable, 1989). The D-TP group also displayed greater *behavioural* manifestations of stress, although this finding did not reach significance, even with secondary univariate analysis. The *emotional* manifestations of stress reported by the groups were lowest for the D-TP group, although not significantly lower than either of the other groups.

Overall, these results are somewhat concurrent with the findings from Alexander-Passe (2008), who claimed to have demonstrated (despite the sole reliance on descriptive statistics) that the primary manifestation of school-related stress for his clinic-referred dyslexic group was *emotional* stress and the secondary manifestation was *physiological* stress. With a similar age group to this study, Helms (1996) reported significantly greater manifestations of stress for her learning-disabled group in comparison to controls in the behavioural and physiological scale. In the present study, the physiological manifestation of stress was the only manifestation of stress scale to be significantly different, and higher, for the D-TP group, according to the statistical analysis. Further replication studies of a larger scale may reveal other significant manifestations of stress for a D-TP group. The one concordance from this study, with

two identified similar studies, is that students with a D-TP are likely to experience *physiological* manifestations of stress, explicitly related to the school-context.

Summary of Discussion

This study produced what is suggested to be a relatively high prevalence figure of 11%, for a dyslexic-type profile in New Zealand. Possible reasons for this figure were discussed in relation to methodology and the New Zealand context and pedagogical approaches to reading instruction. The study demonstrated that a discrepancy between listening comprehension and reading comprehension, along with low word-level decoding skill (i.e., a dyslexic-type profile), rather than low reading comprehension alone (generic poor readers), is likely to co-exist with increased levels of anxiety and school-related stress. Specifically, students with a dyslexic-type profile were found to experience greater *generalised* anxiety than generic poor readers as a primary association. They were also found to experience the secondary associations of greater *social* anxiety and *obsessive-compulsive* anxiety than generic poor readers and students with no significant reading difficulties. Students with a dyslexic-type profile reported greater *academic self-concept* stress than their proficient reading peers and greater *physiological* manifestations of stress than generic poor readers. Potential reasons for these findings were discussed within a social-cognitive framework and with reference to the specific New Zealand context.

Chapter Six: Conclusion

There has been widespread and persistent opposition to the categorisation of learning difficulties such as dyslexia in New Zealand (Clay, 1987; New Zealand Psychological Society, 2015). As such, New Zealand's education system has lagged behind other countries in its recognition and identification of dyslexia, with no current data in relation to prevalence. A prevalence estimate is needed, as the absence of such information may have implications for the wider acknowledgement of dyslexia, as well as funding and resourcing. Additionally, given that dyslexia has gone unrecognised and unidentified in the New Zealand education system, it was also of interest to examine the emotional correlates of a dyslexic-type profile in primary-aged students when compared to generic poor readers and readers with no significant difficulties. This is an area of research that has received no attention in New Zealand.

This quantitatively orientated study utilised existing methodology proposed by Nicholson and Dymock (2015), based on the *Simple View of Reading* to identify three reading groups with differing reading and comprehension profiles: a dyslexic-type profile; generic poor readers and readers with no significant reading difficulty. All participants were administered an anxiety questionnaire (the Spence Children's Anxiety Survey [Spence, 1998a]) and a questionnaire examining school-related stress (the School Situational Survey [Helms & Gable, 1989]). Quantitative analysis of this data was then carried out, using SPSS, to answer four research questions.

The first research question was a simple investigation into the prevalence of a dyslexic-type profile in 8-10-year-old students in New Zealand. At first, the figure of 11% appeared consistent with other prevalence figures in the literature. However, due to the comparatively stringent methodological criteria in this study, it was suggested that this figure might be an underestimate and that prevalence for a D-TP is likely to be elevated in New Zealand, in comparison to reported prevalence rates for other countries. The second research question then investigated whether or not students with a D-TP reported higher levels of anxiety than either of the two peers groups, across various anxiety dimensions. The study's findings revealed that the D-TP group did report greater *generalised anxiety* than the generic poor reader group; greater *social phobia* than both groups and greater *obsessive-compulsive* anxiety than the group with no significant reading difficulties. The final two research questions examined whether or

not students with a D-TP reported higher levels of stress within *source of stress* subscales and *manifestation of stress* subscales. The study found that within the sources of stress subscales the D-TP group reported greater *academic self-concept stress* than peers with no significant reading difficulties. Finally, participants with a D-TP reported greater *physiological stress*, when compared to generic poor readers, within the manifestation of stress subscales.

Contributions to the Literature

The findings from this study have contributed to the literature in the field of dyslexia and anxiety. First, this study has added an initial exploration into the New Zealand prevalence of a dyslexic-type profile, operationally defined by the *Simple View of Reading*, and has provided tentative evidence for a New Zealand-specific, relatively high prevalence rate. This has gone some way to address the paucity of up to date prevalence studies related to dyslexia in New Zealand. Furthermore, this evidence is considered pertinent, as existing prevalence figures have mainly arisen from countries with a long-standing awareness of dyslexia; educational policies in place, relating to dyslexia and its identification; and use of adequate targeted instruction.

Second, the present study represents the first attempt to explore emotional issues such as anxiety and stress experienced by New Zealand primary school students with a D-TP. Therefore, this research has added to the knowledge of how dyslexic-type profile readers may differ from their peers in their emotions. Previous studies have predominantly compared a dyslexic group with a control group of typical readers (Carroll et al., 2005; Novita, 2016), or a third comparison group with additional learning disorders (Mammarella et al., 2016; Martinez et al., 2004; Willcutt et al., 2013). The study contributed to this field by highlighting the specific difference in the emotional experience of students with a D-TP, compared to those with more generic poor reading.

This study has added value to the field by examining stress and dyslexia in three identifiable ways that previous research has not. This is the first study in New Zealand to specifically examine and contribute to the understanding of the school-related stress experienced by primary school children with a D-TP. Second, this research examined and compared school-related sources of stress in D-TP children with other poor readers and with proficient readers, as opposed to the study by Helms (1996), which examined

stress in a broader general cohort of learning disorders, or the study by Alexander-Passe (2008), which compared dyslexic students' stress with that of their siblings. Third, this study attempted to contribute to this area by overcoming the identified design and analysis limitations (i.e., the potential sample bias and lack of methodological rigour) of previous research by Alexander-Passe (2008). The current study drew the groups from the general population, permitting greater generalisability of findings; categorised the comparison groups based on distinct criteria of achievement; and improved on the previous study by reporting statistical findings beyond descriptive statistics. It is suggested that this improved methodological rigour increases the reliability of findings and our understanding of how and potentially why students with a D-TP may experience more stress.

In summary, this study began by contributing to the literature through the use of an SVR-operationalised definition of dyslexia to produce a New Zealand-based prevalence rate for a D-TP. The study then added to our conceptualisation of dyslexia, as a dimensional framework of proximal symptoms, including the associated psychopathology of elevated generalised anxiety, with secondary associations with obsessive-compulsive and social anxiety. While no causal statements can be made, this study contributes to our understanding of how the emotional experience of being an 8-10-year-old student in New Zealand with a D-TP is distinguishable from the emotional experience of being a generic poor reader or a student with no significant reading difficulties.

Implications and Recommendations

From this study, implications for policy arise from the demonstrably high prevalence rate for a dyslexic-type profile and the associated emotional distress identified with this profile. The most notable implication is that new governmental policy; i.e., the *Learning Support Action Plan* (MoE, 2019), which includes the requirement to implement screening for dyslexia in primary schools, can be considered timely, for students with this profile in New Zealand schools. Moreover, tentative recommendations for the implementation of this policy can be drawn from this research.

One of the key goals in the Ministry of Education's Learning Support Action Plan (MoE, 2019) is the strategic prioritisation of screening "at certain stages" for

identification of dyslexia, with a focus on learning needs (as opposed to diagnosis) and a need for the development of evidence-based screening tools. While the MoE's commitment to screening in the preschool and initial year of school is commendable, other screening tools are required for different developmental stages, to help ensure that no child is left behind. This study has demonstrated the utility of the SVR as a viable framework to identify a dyslexic-type profile of need, for the developmental stage of 8-10-year-olds within New Zealand. This profile is useful for classification, but the greatest benefit of this method of identification lies in its ability to identify the reading-related skill deficit of word-level decoding within this profile, as a key focus for learning. The SVR framework fits well with the implementation of screening tools proposed by the Learning Support Action Plan (MoE, 2019), as it concurs with their non-diagnostic stance, by instead identifying a profile of need. As such, the method demonstrated in this study is recommended as a potential solution to the implementation of screening for dyslexia, as it goes some way to providing an evidence base for the SVR to be adopted as a preliminary assessment for the identification of dyslexia in 8-10 year-olds.

This study found that students with a dyslexic-type profile show anxiety levels above that reported by their poor reading and proficient reading peers, in more than one subscale of anxiety. The implications of this finding for practise is considered in relation to the recent recommendations from the Office of the Children's Commissioner, who stated, "Any policy and practice that impacts on the wellbeing of children should have the objective of reducing disparities" (MoE, 2019b, p. 49) and in relation to the Education Review Office's (2016) recommendation that all students' wellbeing is actively monitored. Although not all students with a dyslexic-type profile will exhibit elevated anxiety, the epiphenomenon of anxiety sitting alongside a D-TP and the worrying implications of elevated anxiety in youth should be considered.

It is recommended that teachers and other education practitioners should be aware of the correlation and alert to the possibility that students with this profile may also experience this negative emotion for the following two reasons. First, anxiety is thought to interfere with information processing systems (Eysenck, Derakshan, Santos, & Calvo, 2007), which is a deficiency that is understood to already exist for students with dyslexia. This dual cognitive processing interference is likely to have major

repercussions for academic attainment. Second, given that specific learning disorders such as dyslexia and on-going, elevated anxiety have been identified as significant risk factors for drug and alcohol difficulties, as well as suicidal ideation (Garlow et al., 2008; McBride & Siegel, 1997; McGorry, Purcell, Hickie, & Jorm, 2007), it is recommended that practitioners are equipped with tools, or training, to identify such distress. It is further recommended that training in strategies to help students deal with anxiety, should be prioritised alongside strategies aimed at closing the gap on the reading skill deficit associated with this profile. An emphasis on evidence-based tools and strategies, as well as information about the negative emotions that may co-exist with dyslexia should be included in teacher training programmes in New Zealand if we have any hope of identifying and reducing the disparities.

The finding that the D-TP group have greater *academic self-concept* stress has practical implications that relate to the communication of assessment data within the classroom. The reading ladder with little monkeys sitting at their reading level is a common feature in junior classrooms around the country. While no doubt designed with motivational intentions, there is implicit communication here that begins as soon as the child enters school. For the D-TP underachieving child near the bottom of the ladder, who is perhaps already aware of their own discrepant performance, this could quite possibly lead to stress in the area of academic self-concept. Span forward a few years and the child may be asked to sit in a parent evening, where stanines results from standard classroom assessments, such as those provided to the researcher for this study, are made explicit. The inherent message the student receives is that when performing below a stanine four result, their attainment is less than average. In practice, educators should be careful in their communication of data that may undermine academic self-concept for underachieving students.

There are also important implications to be considered in response to the finding that the D-TP group demonstrate elevated *physiological* stress. Researchers have documented the long-term effects of physiological stress on general health (Vrijkotte, Van Doornen, & de Geus, 2000), including immune system suppression (Sapolsky, 2004), and further psychological or physiological difficulties (Charmandari et al., 2005). While it is acknowledged that not all dyslexic students will experience physiological stress, one recommendation to help all students develop control over

physiological symptoms of stress, would be for educators to introduce and instruct students in the use of interventions such as breathing techniques and mindfulness training (Albrecht, Albrecht & Cohen, 2012; Dubarle, Bernet, Brun, & Shankland, 2019).

Finally, there are implications that arise from this study for distinguishing a D-TP group, not only by an achievement discrepancy and low decoding skills but by an emotional profile. Essentially, these findings permit the beginnings of a challenge to the New Zealand Psychological Society viewpoint that, "Dyslexia is no longer a useful diagnosis to discriminate a group of students from other poor readers" (NZPsS, 2015, p. 5). It is therefore recommended that this perspective is itself no longer useful, but rather serves the negative function of creating barriers for the identification and recognition of the specific dyslexic profile of strength and weakness, and the emotional symptoms that distinguish this group from other poor readers and peers.

Limitations

Issues related to sample size and the possibility of a participant bias should be considered when interpreting this study's prevalence finding. While a prevalence estimate requires a simple formula, adequate sample size is required to estimate population prevalence with reasonable precision. According to a sample size calculation for cross-sectional prevalence studies (see Appendix Z), a sample size of 203 participants was considered an adequate sample size for a precise prevalence estimate for this study. This study's sample size fell short of this, and the prevalence finding should, therefore, be treated with caution and as an exploratory analysis. A further limitation of the sample size was the lack of ability to make significant statements in relation to gender differences. Beyond the apparent limitations of sample size, it should also be considered that the higher prevalence rate may have resulted from a participant bias. Parents who suspected their children of having reading difficulties might have provided consent to participation in the study, whereas parents without such concerns may not have been so motivated for their child to participate.

Some limitations must be considered alongside data interpretation for the anxiety and stress findings. First, the cross-sectional nature of the study does not allow for conclusions to be drawn with regards to the direction of cause for the identified

associations. Second, despite the D-TP group reporting more considerable anxiety across every dimension of anxiety, these differences did not reach significant levels across many dimensions. Meanwhile, medium to large effect sizes were identified for some analyses, while significant results were not. The sample size was more than likely too small to yield enough power to identify differences in mean anxiety and stress scores between groups as significant. Sekaran (2003) advises that sample size should be at least ten times as large as the number of variables, when carrying out multivariate statistics; a recommendation that was not met by this study. Larger sample size may have reduced this risk to produce further significant findings. Third, with the second round of analysis (which utilised multiple t-test statistics to compare group mean scores on anxiety and stress dimensions), we must also acknowledge the risk of type 1 error (i.e., erroneously rejecting the null hypothesis). Therefore, the significant results in relation to *elevated social phobia anxiety, obsessive-compulsive anxiety* and *academic self-concept stress* for the dyslexic-type group must be interpreted with some caution. However, the converse is also true. While interpreting the results of the multivariate analysis, which revealed one significant difference, caution must also be exercised. Due to the risk of a type 2 error, there is a possibility that real differences are not detected as significant. Overall, the risk of these errors acts as a limitation on the interpretation of the study's findings in relation to anxiety and stress being significantly different in a D-TP.

General limitations. The final identified limitations relate to sample characteristics and context. This study did not identify what approaches to reading instruction were being utilised in the classroom and what, if any, interventions were being received by the students. It is possible that interventions of any description would reduce anxiety or stress levels for D-TP students, which would possibly reduce the likelihood of a significant difference being identified. Finally, while this study attempted to circumvent the effects of referral bias and the associated consequence of limiting the generalisability of findings, that is evident in many related studies (i.e., Dahle et al., 2011; Davis et al., 2017; Mammarella et al., 2016; and Novita, 2016), a participant bias may still exist within the sample in two forms. First, as identified in the methodology, children whose parents agree for their children to participate in the study may differ from those who do not, in meaningful ways (Robson, 2011). Secondly, parents who selected to have their children involved in the study may also provide

support in the home that mitigates against the risk of secondary effects of dyslexia, with parental social support acting as a buffer, as suggested by Freeman and Rees (2010). Different findings may have emerged if non-consenting parents had allowed their children to participate.

Considerations for Future Research

Reliable prevalence data is helpful to both encourage research and to influence policy around resourcing. Further studies of a larger scale are necessary, to state prevalence figures with more reliability. Such research would help confirm what is potentially a higher rate of prevalence within New Zealand; would further the discussion about why this may be the case and would help justify and enable targeted school resourcing, such as staff, funding and programming. Reliable prevalence data would also potentially invite further intervention research within New Zealand and perhaps encourage appropriate resource allocation for such research-based intervention.

With regards to future research into the emotional correlates of dyslexia, there are multiple directions that future studies could follow. Qualitative research examining the socioemotional experiences and perspectives of primary aged students with this D-TP would allow further inferences that are not permitted by this study's design, concerning the reasons for the specific dimensions of elevated anxiety and stress. While there are incredibly informative qualitative studies focussing on adolescents with dyslexia (Burden, 2005) and adults with dyslexia in further education (Cameron, 2016; Nalavany, Carawan & Rennick, 2010; and in New Zealand: Rowan, 2010), future research could add to this body of work, by carrying out similar qualitative research aimed at primary school students. Mixed method replication studies could use parental and student interviews to elucidate the effects on reported anxiety in relation to perceived and real parental social support received by D-TP students. Finally, longitudinal studies within New Zealand, with published effect sizes, examining anxiety and stress correlates of D-TP children throughout their schooling years, would shine a light on developmental variations and help unearth the direction of causation.

This study was unable to test whether the difference in anxiety experienced by the D-TP students is a result of having a D-TP or whether there is a bidirectional influence. Given the seemingly robust nature of generalised anxiety for students with

dyslexia and this dyslexic profile, intervention studies are called for to signpost ways in which anxiety may be ameliorated for these students and to allow the direction of causality to be explored for this association.

A useful development for research would be to expand on this work by carrying out larger-sample replication studies. Differences were found that did not reach significance between the D-TP group and peer groups across all dimensions of anxiety and sources of stress, suggesting that further research would require larger sample sizes, to verify if further anxiety dimensions that did not reach significance, are correlates of dyslexia. Such studies should also attempt to ascertain interventions being received by groups and the instructional approach to literacy within the classrooms and schools. This would allow statements of speculation regarding the possible effects of whole language versus phonics instruction to become statements of likelihood. Overall, future research on a larger scale is required to add to the reliability of these findings and to inform policymakers, and professionals tasked with the responsibility of enhancing learning opportunities, and easing suffering, of children and young people with this profile.

Concluding Statements

The significance of this study lies in its original contribution to research, and its timely, pragmatic value in New Zealand. The experimental work presented here provides one of the first investigations into the prevalence of a D-TP, based on the *Simple View of Reading*, in New Zealand. It is hoped that the evidence-based characterisation of dyslexia based on the operationalised Simple View of Reading will increase teacher awareness of the accessibility of this preliminary assessment method for screening for a dyslexic-type profile, with middle school children. While this method does not purport to replace a diagnostic assessment for dyslexia, it allows for students with a dyslexic-type profile to be identified at minimal cost and without the burden of lengthy 1:1 assessment. This screening method will also indicate a group of students who may require additional emotional wellbeing support, as well as specific reading skill development.

Last, it is hoped that this research will contribute to the on-going debate in New Zealand, regarding an operationalised definition of dyslexia and acceptance of the

validity of the construct. The current study, adopts a clear operationalised definition for a D-TP, with specific criteria and cut-off points to address this problem. This study provides new insights into the emotions that co-exist with a dyslexic-type profile when compared to other poor readers and it is hoped that this will contribute to a deeper understanding of a dyslexic profile being clearly distinguishable from that of more generic poor readers. Without identification and recognition of their specific difficulties, students with a dyslexic-type profile are likely to continue to experience anxiety in relation to what must feel like insurmountable challenge or stress within our education system. In New Zealand education and research, the time has come to draw the focus away from debates on the existence of dyslexia and to focus on what can be done to identify these students and to close the gap and social injustice for students with a dyslexic-type profile in terms of their discrepant achievement and wellbeing.

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Appendices

Appendix A. Dyslexia definitions from key governing bodies, institutes and organisations.

Country	Institute/ Organisation	Definition
International	**International Classification of Diseases (ICD-11) [World Health Organisation, 2019]**	Developmental learning disorder with impairment in reading is characterized by significant and persistent difficulties in learning academic skills related to reading, such as word reading accuracy, reading fluency, and reading comprehension. The individual's performance in reading is markedly below what would be expected for chronological age and level of intellectual functioning and results in significant impairment in the individual's academic or occupational functioning. Developmental learning disorder with impairment in reading is not due to a disorder of intellectual development, sensory impairment (vision or hearing), neurological disorder, lack of availability of education, lack of proficiency in the language of academic instruction, or psychosocial adversity.
International	**International Dyslexia Association (2015)**	Dyslexia is 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.
USA	**Diagnostic Statistical Manual (DSM-5) (American Psychological Association, 2013)**	A Specific Learning Disorder with impairment in reading. Dyslexia is a neuro-developmental disorder with behavioural manifestations associated with cognitive abnormalities. Diagnosis requires persistent learning difficulties in academic skills; specifically, reading of single words accurately and fluently, and reading comprehension (DSM-5). Furthermore, the learning problems must manifest as observable behaviours and individuals achievement relative to age must be well below average, on the specific skill. Although the DSM-5 acknowledges that no natural cut-off point for SLD diagnosis exists, it suggests a criterion of -1.5 S.D, below age norms or a Standard Score of ≤78, will provide the greatest diagnostic certainty.
Britain	**The Scottish Executive (2009)**	Dyslexia can be described as a continuum of difficulties in learning to read, write and/or spell, which persist despite the provision of appropriate learning opportunities. These difficulties often do not reflect an individual's cognitive abilities and may not be typical of performance in other areas.
New Zealand	**The Ministry of Education (2008)**	A spectrum of specific learning difficulties and is evident when accurate and/or fluent reading and writing skills, particularly phonological awareness, develop incompletely or with great difficulty. This may include difficulties with one or more of reading, writing, spelling, numeracy or musical notation. These difficulties are persistent despite access to learning opportunities that are effective and appropriate for most other children.

New Zealand	New Zealand Dyslexia Foundation (2006)	A specific learning difference which is constitutional in origin and which, for a given level of ability, may cause unexpected difficulties in the acquisition of certain literacy and numeracy skills.
Britain	British Psychological Society(1999)	Dyslexia is evident when accurate and fluent word reading and/or spelling develops very incompletely or with great difficulty. This focuses on literacy learning at the 'word level' (reading a word with no cues from any context in a sentence, no pictures, etc.) and implies that the problem is severe and persistent despite appropriate learning opportunities. It provides the basis for a staged process of assessment through teaching.
Britain	British Dyslexia Association (2014)	Dyslexia is a specific learning difficulty which mainly affects the development of literacy and language-related skills. It is likely to be present at birth and to be lifelong in its effects. It is characterised by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual's other cognitive abilities. It tends to be resistant to conventional teaching methods, but its effects can be mitigated by appropriately specific intervention, including the application of information technology and supportive counselling.

Most prominent deficits: Reading deficit(6); literacy deficit(6); word reading deficit(3).
Less prominent deficits: phonological awareness(3); numeracy(2); working memory(1)

Appendix B. Symptom descriptions for anxiety dimensions from the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-V [APA, 2013]).

Anxiety domain	DSM-V Symptom Criteria (brief)
Separation anxiety	Recurrent excessive distress when anticipating or experiencing separation from home or from major attachment figures.
	Persistent and excessive worry about losing major attachment figures or about possible harm to them, such as illness, injury, disasters, or death.
	Persistent and excessive worry that an untoward event will lead to separation from a major attachment figure
	Persistent reluctance or refusal to go out, away from home, to school, to work, or elsewhere because of fear of separation.
	Persistent and excessive fear of or reluctance about being alone or without major attachment figures at home or in other settings.
	Persistent reluctance or refusal to sleep away from home or to go to sleep without being near a major attachment figure.
	Repeated nightmares involving the theme of separation
	Repeated complaints of physical symptoms (such as headaches, stomach-aches, nausea, or vomiting) when separation from major attachment figures occurs or is anticipated.
Specific phobia	Unreasonable, Excessive Fear: The person exhibits excessive or unreasonable, persistent and intense fear triggered by a specific object or situation.
	Immediate Anxiety Response: The fear reaction must be out of proportion to the actual danger and appears almost instantaneously when presented with the object or situation.
Social phobia	Marked fear or anxiety about one or more social situations in which the individual is exposed to possible scrutiny by others. Examples include social interactions (e.g., having a conversation, meeting unfamiliar people), being observed (e.g., eating or drinking), and performing in front of others (e.g., giving a speech).
	The individual fears that he or she will act in a way or show anxiety symptoms that will be negatively evaluated (i.e., will be humiliating or embarrassing; will lead to rejection or offend others).
Agoraphobia	A marked fear or anxiety about two (or more) of the following five situations:
	Using public transportation
	Being in open spaces
	Being in enclosed spaces (e.g., shops, theatres, cinemas)
	Standing in line or being in a crowd
	Being outside the home alone.
Generalised Anxiety	Excessive anxiety and worry (apprehensive expectation), occurring more days than not for at least 6 months, about a number of events or activities (such as work or school performance). The individual finds it difficult to control the worry. The anxiety and worry are associated with three (or more) of the following six symptoms (With at least some symptoms having been present for more days than not for the past 6 months). Note: Only one item is required in children
	1. Restlessness or feeling keyed up or on edge.
	2. Being easily fatigued.
	3. Difficulty concentrating or mind going blank.
	4. Irritability.
	5. Muscle tension.
	6. Sleep disturbance (difficulty falling or staying asleep, or restless, unsatisfying sleep)
Obsessive-compulsive	Presence of obsessions, compulsions, or both
	Obsessions are defined by; Recurrent and persistent thoughts, urges, or impulses that are experienced, at some time during the disturbance, as intrusive and unwanted, and that in most individuals cause marked anxiety or distress.
	The individual attempts to ignore or suppress such thoughts, urges, or images, or to neutralize them with some other thought or action (i.e., by performing a compulsion).
	Compulsions are defined by; Repetitive behaviours (e.g., hand washing, ordering, checking) or mental acts (e.g., praying, counting, repeating words silently) that the individual feels driven to perform in response to an obsession or according to rules that must be applied rigidly.
	The behaviours or mental acts are aimed at preventing or reducing anxiety or distress, or preventing some dreaded event or situation; however, these behaviours or mental acts are not connected in a realistic way with what they are designed to neutralize or prevent, or are clearly excessive.
	Note: Young children may not be able to articulate the aims of these behaviours or mental acts.
Panic Disorder	A discrete period of intense fear or discomfort, in which four or more of the following symptoms developed abruptly and reached a peak within 10 minutes Palpitations, pounding heart, or accelerated heart rate, Sweating Trembling or shaking Sensations of shortness of breath or smothering Feeling of choking Chest pain or discomfort; Nausea or abdominal distress Feeling dizzy, unsteady, lightheaded, or faint Derealization (feelings of unreality) or depersonalization (being detached from oneself) Fear of losing control or "going crazy" Fear of dying; numbness or tingling sensation or chills or hot flushes.

Appendix C. Ethics approval

Date: 04 December 2018

Dear Heather Smith

Re: Ethics Notification - NOR 18/62 - Dyslexia and anxiety: a New Zealand study

Thank you for the above application that was considered by the Massey University Human Ethics Committee: **Human Ethics Northern Committee** at their meeting held on **Tuesday, 4 December, 2018**.

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

Appendix D. Principal information letter and informed consent form.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Dyslexia, Anxiety and Sources of Stress: A New Zealand Study
Project Information & Letter of Invitation School Principals

Dear (Principal's name),

My name is Heather Smith. I am a Masters-level researcher and I live and work here on the ▮▮▮ Coast with my family. I am a registered Primary Teacher and Post Graduate Masters Student at Massey University. I am conducting research on Dyslexia and Anxiety under the supervision of Dr. Jayne Jackson and Dr. Peter Rawlins and I would like to invite you to consider your school taking part in this research. If your school volunteers to participate, the study will take place during term 1, 2019.

Aims of the Research

The research aims to:

- utilize results from routine-based classroom assessment tools (specifically, the PAT: Listening Comprehension and the STAR Reading test) to demonstrate the identification of students with characteristics consistent with a dyslexic profile, in a New Zealand cohort of students aged 8 – 10-years-old.
- assess measures of anxiety and potential sources of stress experienced by a group of students identified as having a dyslexic-type profile, compared with peers.

Significance of the Research Project

The research is significant in two ways:

1. The research will demonstrate a way in which teachers can utilise classroom-based, accessible and affordable assessment tools for the identification of students with characteristics consistent with a dyslexic profile
2. It will provide information about the socio-emotional profile and experiences of children with a dyslexic-type profile.

Benefits of the Research to Schools

Access to a summary of the completed thesis, demonstrating a methodology that is easily accessible and practical for teachers, in helping them to identify students with a dyslexic-type profile. The Principal will be given a summary of the identified Sources of Stress findings, in graph form, from across the combined schools' cohort with no identifying names of children or schools. It is hoped that there will be around 220 students from the ▮▮▮▮▮▮▮▮▮▮ area participating in this study. Involvement shows a commitment to exploring the socio-emotional welfare of students as well as their learning.

Research Plan and Method

Participant data from the teacher-administered reading test (STAR test) and the teacher-administered listening comprehension test (Progressive Achievement Test: Listening Comprehension) will be provided to the researcher. From this data, the researcher will then carry out a 10-minute 1:1 reading test (The Martin Pratt Non-word Reading Test) with a group of participants that meet specific criteria. All participants will be asked to respond to two questionnaires, designed to assess anxiety levels (The Spence Children's Anxiety Scale) and sources of stress (The School Situation Survey). Further details of these tests are attached in a summary statement. These combined questionnaires will take 30 minutes to complete in total and will be read to the group of assenting participants within your school as a group, with the students responding by circling their answers.

The Principal will be informed of sources of stress, as amalgamated data from the participating schools' population cohort. No names of students, schools or personnel will be evident in this data. All

information collected will be treated in strictest confidence and neither the school nor individual learners will be identifiable in any reports that are written. The exception to this is if a student's anxiety scores place him/her above a threshold for elevated anxiety. In this instance, for ethical reasons, the particular child's parents will be informed. Similarly, if individual students' results indicate characteristics consistent with a dyslexic profile , his/her parents may select to be informed of this result. Participants may withdraw from the study up to two weeks after the completion of data collection.

The role of the school is voluntary and the School Principal may also decide to withdraw the school's participation at any point up to two weeks after the completion of data collection.

School Involvement
If you do decide to consent to your students' participation, I will contact you for a list of your students who fall in the 8-10-year-old category (as of 14th February, 2019) and the names of those classroom teachers. I will then;
- Invite parents to an information evening, where they will have an opportunity to ask questions and view the assessment tools.
- Arrange for informed consent to be obtained from participants' parents.
- Request an opportunity from the classroom teacher, to talk to the students about the project, their potential participation and assent.
- Thereafter, I will request a time with your classroom teachers for data collection to begin.

Further information
Included in this information pack is:
- This letter of invitation
- A copy of the Parent Information and Consent Form
- The Participant Information Statement Form
- A description of the *Martin and Pratt Non-word Reading Test, The Spence Children's Anxiety Scale* and *The School Situation Survey*

Should you wish any further details, please do not hesitate to contact me by email (masseyresearcher@gmail.com) or telephone ▮▮▮▮▮▮ Alternatively, you may contact my Supervisor, Dr Jayne Jackson, by email (J.H.Jackson@massey.ac.nz), with any questions or concerns.

Invitation to Participate
If you would like your school to participate in this research, please complete and return the attached form, by return. Thank you for taking the time to read this information.

Kind Regards,

[signature]

Heather Smith
Post Graduate Student
Massey University

Dr Jayne Jackson
Researcher Supervisor
Massey University

Dr Peter Rawlins
Co-supervisor
Massey University

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/62. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair), Massey University Human Ethics Committee: Northern, email humanethicsnorth@massey.ac.nz .

Dyslexia and Anxiety: A New Zealand study

School Principal Consent Form

Following the gaining of informed consent by parents, I hereby give consent for you to approach 8-10-year-old learners within _____ School, to participate in *Dyslexia, Anxiety and Sources of Stress: A New Zealand study*.

I have read the Project Information Statement explaining the purpose of the research project and understand that:

- The role of the school is voluntary.
- I may decide to withdraw the school's participation up to two weeks following the completion of data collection.
- 8-10-year-olds (at February 14th, 2019) will be invited to participate, following Principal and parental consent both being gained.
- Only learners who themselves assent and whose parents consent will participate in the project.
- All information obtained will be treated in strictest confidence.
- The learners' names will not be used and individual learners will not be identifiable in any written reports about the study.
- The school will not be identifiable in any written reports about the study.
- Participants may withdraw from the study up to two weeks after the completion of data collection.
- I may seek further information on the project from Heather Smith on ▮▮▮▮▮▮▮ or by email (masseyresearcher@gmail.com)

_____   _____
Principal   **Signature**

_____
Date

Please return, (before the end of term 4, 2018) in the enclosed SAE. Alternatively, scan the signed consent form and email to the researcher (Heather Smith) at: masseyresearcher@gmail.com

Appendix E. Assessment tool summary

Assessment Tools Summary

1. The Martin and Pratt Non word Reading test:

The Martin and Pratt Non-word Reading Test (Martin & Pratt, 2001) is a standardized test (Australia normed, 2001) of non-word reading that consists of one form with 54 questions. It takes approximately 10 minutes to administer. An example page from the test booklet (page 9) is shown below. The researcher will introduce the first items by saying, *"I'm going to show you some words that are made up words. They are not real words...they are words that an alien has made up, but that we can still say. When I point at a word, I want you to look at the word and say it aloud to me. Remember they are not real words. Just take as much time as you need and try your best. OK?"*

yil   juf   rint

dilt   kig   og
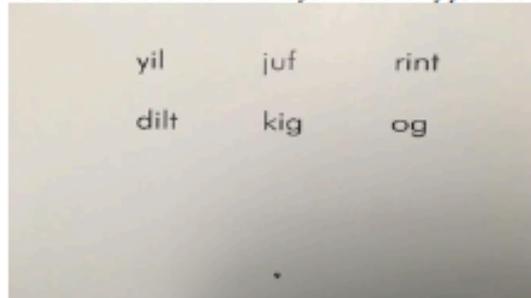
This test has the benefit of a stopping rule, which means that I stop testing if the student is struggling to read the items, as they get progressively more difficult.

2. The Spence Children's Anxiety Scale (SCAS)

This questionnaire comprises 45 questions, designed to assess the nature and extent of anxiety symptoms within recognised dimensions. It is designed to be relatively easy and quick for children to complete, taking around 10 minutes to answer the questions. Young people are asked to rate the degree to which they experience each symptom on a frequency scale. This questionnaire consists of 44 questions, of which 38 reflect specific symptoms of anxiety and 6 relate to positive, filler items to reduce negative response bias(e.g., item 31, below). Children are asked to rate on a 4-point scale; never (0), sometimes (1), often (2), and always (3), the frequency with which they experience each symptom. The instructions state, *"Please put a circle around the word that shows how often each of these things happens to you. There are no right and wrong answers"*. The questions will be read aloud to the participants, by the researcher.

Importantly, the SCAS is not being used as a diagnostic instrument in this study. Rather, it is designed to provide an indication of the nature and extent of anxiety symptoms across of cohort and groups within that cohort. However, If a child is showing elevated anxiety symptoms, the parent/care-giver will be informed of this.
Below is an example of four of the 44 items in the questionnaire;

10. I worry that I will do badly at my school work... Never Sometimes Often Always
29. I worry what other people think of me.. Never Sometimes Often Always
31. I feel happy.. Never Sometimes Often Always
34. I suddenly become dizzy or faint when there is no reason............. Never Sometimes Often Always

3. The School Situation Survey

This questionnaire is designed to identify the presence/absence of particular sources and manifestations of stress. The questionnaire comprises 34 statements which will be read aloud to the students. The participants will be given the following instructions: *"A number of statements that students can use to describe themselves will be read to you. Please listen to each statement being read to you and decide how often it seems to describe you. For each statement, circle the appropriate answer, using the following choices: 1 = Never 2 = Rarely 3 = Sometimes 4 = Often 5 = Always.*
There are no right or wrong answers. Remember, choose the response that best describes you"

The following statements are drawn from the test itself, as examples:
1. *I enjoy doing things with my classmates*... 1 2 3 4 5
5. *I worry about not doing well in school* 1 2 3 4 5
8. *Other students make fun of me* 1 2 3 4 5
12. *I get along well with my classmates* 1 2 3 4 5
32. *I try to get attention by acting silly in class* 1 2 3 4 5
33. *I feel angry at school* 1 2 3 4 5
34. *School work is easy for me* 1 2 3 4 5

Appendix F. Parent information letter and informed consent form

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Parental Permission for Children Participation in Research
Title: Dyslexia, Anxiety and Sources of Stress: A New Zealand Study

Dear Parent / Caregiver,

I am a Masters-level researcher and my name is Heather Smith. I live and work here on the ████████ with my family and I am currently embarking upon my Masters Research project, through Massey University, conducting research on Dyslexia and Anxiety under the supervision of Dr Jayne Jackson and Dr Peter Rawlins.

The purpose of this letter is to invite your child to be involved in this research project and to provide you with information that may help your decision as to whether you choose to let your child participate in the project. Please read the information below and feel free to contact me with any questions you might have, before deciding whether or not to give your permission for your child to take part. There will be a local information evening in your town at 7PM, February 10th, 2019, at a location to be confirmed. During this meeting, I will further describe the research project and procedures. You are under no obligation to consent to your child's participation in this study. If you decide to let your child be involved in this study, this form will be used to record your permission.

Purpose of the Study

It is hoped that there will be around 220 students from the ████████ and ████████ area participating in this study. First, the project aims to demonstrate the use of classroom-based assessment tools to identify students with characteristics consistent with a dyslexic profile, from within a general population of students in New Zealand. Secondly, this study aims to examine anxiety and potential sources of stress experienced by students identified as having these dyslexic-type characteristics, compared with peers who do not. It is hoped that this study may deepen our understanding of the socio-emotional experiences of students with dyslexic characteristics.

What is my child going to be asked to do?

If you allow your child to participate, the research phase will take place during term 1, 2019. You are being asked to consent to:

- allowing data from classroom tests, that occur within the classroom as normal procedure, to be shared with the researcher.
- your child perhaps being asked to complete a 1:1 reading test with the researcher (10 – 15 minutes). An estimated 10% of consenting participants will be asked to complete this test.
- answering questions read to them from two questionnaires (30 minutes in total).

Information from the routine teacher-administrated reading test (STAR test) and the Progressive Achievement Test: Listening Comprehension(PAT: Listening) will be provided to the researcher by your school Principal. Based on this data, certain participants will complete a 10-15 minute reading test with the researcher. All participants will be asked to respond to two further questionnaires(The Spence Children's Anxiety Scale and the Sources of Stress Survey). Attached to this information sheet is further details of the assessments and examples of questions your child may encounter in the three researcher administered tests. You have the opportunity to view these tests in their entirety at the information evening on the 19th of February.

Your child will receive no direct benefit from this study. However, you can choose to be informed of whether or not your child is displaying characteristics consistent with a dyslexic profile, if you select this option below. If your child's questionnaire results indicate anxiety levels which are significantly elevated, you will be informed of this. It is hoped that the broader benefits of the study include a growing awareness of both classroom-based assessment methods for indication of dyslexia and an increased awareness of any socio-emotional correlates of dyslexia. This is a research study and, therefore, not intended to provide diagnosis or intervention for dyslexia.

Does my child have to participate?
No, your child's participation in this study is voluntary. Your child may decline to participate or withdraw from participation at any time, up until two weeks following completion of data collection. Similarly, after your consent, your child may or may not be selected to participate.

What if my child does not want to participate?
If your child does not want to participate they will not be included in the study. If your child initially agrees to be in the study they can change their mind later and not be included in the study

How will your child's privacy and confidentiality be protected if s/he participates in this research study?
Your child's privacy and the confidentiality of his/her data will be protected by the researcher. If you choose to participate in this study, your child's data will be stored securely and only the research team (myself and my supervisors, Dr Jayne Jackson & Dr Peter Rawlins) will have access to the completed questionnaires and data. Data and questionnaires will be stored securely for five years and then destroyed.

Who to contact with questions about the study?
Prior to, during or after your child's participation you may contact the researcher [Heather Smith] by [redacted] or email [masseyresearcher@gmail.com] with any questions or concerns. Alternatively, you may contact my Lead Supervisor, Dr Jayne Jackson, by email (J.H.Jackson@massey.ac.nz).

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Parental / Caregiver Contact Details (Please complete):

Address: _____

Email: _____

Telephone number: _____

Please provide this further information:

My child has one (or more) of the following:	
• English as a second language • Speech and/or language delays • Hearing impairment • Vision Impairment • Developmental disorder	**YES / NO** (please circle one)

Consent:
You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above, fully understood the study procedure and have decided to allow them to participate in the study. If you later decide that you wish to withdraw your permission for your child to participate in the study you may discontinue his or her participation at any time, up until two weeks following the completion of data collection.

- **I do/do not** wish my child_____(first name)_____(family name) to participate in the research project. (Please circle one)
- **I do/do not** wish to be informed if my child's data indicates dyslexic-type tendencies. (Please circle one)
- I understand that I will be informed if my child's data indicates anxiety levels that are out-with normal levels for students of her/his age.

My Child is currently attending _____School.

Signature of Parent(s) or Legal Guardian:_____ Date:_____

Signature of Researcher: _____ Date_____

Please sign and deposit in the sealed box in your child's school office, by the end of Week 4 (Term 1, 2019). Alternatively, return to the researcher in the SAE provided.

_____

Appendix G. Information sheet for classroom teacher

Dyslexia, Anxiety and Sources of Stress: A New Zealand Study
Project Information for Classroom Teachers

Heather Smith
(Post Graduate Researcher)
Email: masseyresearcher@gmail.com
Telephone: ▮▮▮▮▮▮▮

Dear Classroom Teacher,

I am a Masters-level researcher and my name is Heather Smith. I live and work here on ▮▮▮▮▮▮▮ with my family. I am a registered Primary Teacher and Post Graduate Student at Massey University. I am currently working towards completing the research-based component of a Masters in Educational Psychology. I am conducting research on Dyslexia and Anxiety under the supervision of Dr. Jayne Jackson and Dr. Peter Rawlins (Massey University) and I am grateful for your school volunteering to participate in this research. The following details are for your information and should you have any questions regarding the research and procedures, please feel free to contact me using the details provided in this form.

Aims of the Research
The research aims to:
- utilize results from routine-based classroom assessment tools (specifically, the PAT: Listening Comprehension and the STAR Reading test) to identify students with a dyslexic profile, in a New Zealand cohort of students (aged 8 – 10-years-old).
- assess measures of anxiety and potential sources of stress experienced by a group of students identified as having dyslexic characteristics, compared with peers who do not.

Significance of the Research Project
The research is significant in two ways:
1. The research will demonstrate a way in which teachers can utilise classroom-based, accessible and affordable assessment tools for the identification of dyslexic-type characteristics in a student population.
2. The research will provide information about the socio-emotional profile and experiences of children with a with a dyslexic profile.

Benefits of the Research to Schools
Access to a summary of the completed thesis, demonstrating a methodology that is easily accessible and practical for teachers, in helping them to identify students with dyslexic-type characteristics. The Principal will be given a summary of the identified Sources of Stress findings, in graph form, from across the combined schools' cohort with no identifying names of children or schools. It is hoped that there will be around 220 students from the Greymouth and the Hokitika area participating in this study. Involvement shows a commitment to exploring the socio-emotional welfare of students as well as their learning.

Research Plan and Method
Only students who assent and whose parents consent, will participate.
1. Participant data from the classroom-teacher-administered reading test (STAR test) and the listening comprehension test (Progressive Achievement Test: Listening Comprehension) will be provided to the researcher.
2. Based on this data, the researcher will then carry out a 10-minute 1:1 reading test (The Martin Pratt Non-word Reading Test) with a group of participants.
3. All participants will then be asked to respond to two questionnaires, designed to assess anxiety (The Spence Children's Anxiety Scale) and sources of stress (The School Situation Survey). These combined questionnaires will take 30 minutes to complete (in total) and will be read to the group of assenting participants within your

school as a group, with the students responding by circling their answers(see the attached summary of assessment tools, with item examples).

The Principal will be informed of sources of stress data, as identified by the students across the participating schools' population cohort. No names of students, schools or personnel will be evident in this data.

All information collected will be treated in strictest confidence and neither the school nor individual learners will be identifiable in any reports that are written. The exception to this is if a student's anxiety scores place him/her above a threshold for elevated anxiety. In this instance, the individual child's parents will be informed. Similarly, if an individual student's results indicate characteristics consistent with a dyslexic-type profile, his/her parents may select to be informed of this result. Participants may withdraw from the study at any time, up to two weeks after the completion of data collection.

School Involvement
I have been provided with a list of students in your school, who fall in the 8-10-year-old category (as of 14th February, 2019). I have:

- invited parents to an information evening, where they will have an opportunity to ask questions and view the assessment tools.

I will now:
- arrange for informed consent to be obtained from participants' parents.
- request an opportunity from yourself (the classroom teacher) to talk to the students about the project, their participation and assent.
- Thereafter, I will request a time with you for data collection to begin.

Further information
Included in this letter is:
- A description of the *Martin and Pratt Non-word Reading Test*, *The Spence Children's Anxiety Scale* and *The School Situation Survey*

Should you wish any further details, please do not hesitate to contact me by email (masseyresearcher@gmail.com) or telephone (▮▮▮▮▮▮▮). Alternatively, you may contact my Supervisor, Dr Jayne Jackson, by email (J.H.Jackson@massey.ac.nz) with any questions or concerns.

Thank you for taking the time to read this information.

Kind Regards,

Heather Smith
Post Graduate Student Researcher
Massey University

Dr Jayne Jackson
Supervisor
Massey University

Dr Peter Rawlins
Co-supervisor
Massey University

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/62. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair), Massey University Human Ethics Committee: Northern, email humanethicsnorth@massey.ac.nz .

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Appendix H. Information sheet for potential student participants.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Hi! My Name is Heather Smith and I am a researcher from Massey University, which is like school for grownups!

I am here today to tell you about my project (which is a bit like a puzzle and a science experiment put together). Your parent/care giver has given permission for you to do this project but I also want to ask you if you want to be part of my project? If you say no, after listening today, that is absolutely fine!

I am trying to spot something called Dyslexia in children your age and to find out if children with dyslexia feel different from their classmates. Dyslexia is a tricky thing to explain and lots of adults around the world are still trying to describe what it is exactly. One thing that dyslexia makes tricky for people is learning to read. I am looking for 8 – 10-year-old children in your school and other schools who might have difficulties reading because of dyslexia and I want to find out how it makes them feel and why.

Before you decide to help me with this puzzle, it is important for you to understand why the research is being done and what you would be asked to do. I will be here at your school in the morning break in the classroom and you are welcome to ask me any questions about this project. You can ask me if there is anything that is not clear.

Why have I been chosen?

I have chosen to work with 8 – 10-year-olds, because the tests that your teachers run with you and that I want to do with you only start at your age and by now, you have been at school long enough to understand and answer the questions about your feelings. Your parents have given permission for you to be part of the study but the last word is definitely up to you.

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Do I have to take part? No. You can choose now, or at any time, to say that you don't want to be part of the project.

What will I have to do if I take part?

> 1. I will need your permission to get your results from your Principal for your reading and listening comprehension tests.

> 2. Some of you will spend ten minutes with me reading weird **alien** words like **zog**.

> 3. You will answer questions about how you feel and about what stresses you out (if anything). I will read out these questions and you will put a circle around your answer on a bit of paper.

This will happen in a space in your school that you already know well; maybe your classroom, another classroom or the school library.

Could anything that feels bad happen?

It may turn out that you are having trouble reading and it looks like dyslexia. Your parent / guardian might have asked to know about this as well. I will not let you, the teachers or the Principal know, but I will ask your parents to talk to you about it first and then for you both to decide who should know after that. Your name will not be written anywhere that anyone else might see it.

Are there any good things about taking part?

If you are having trouble with reading, this may help your parents, you and your teachers to understand what the problem is and how it makes you feel.

What will happen to the results of the research project?

The project results will be in the Massey university library, like a book. No-one will be able to know anything about you from my writing.

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Appendix I. Power point delivered to parents prior to informed consent being provided.

Appendix J.   Safety plan to manage any visible or disclosed distress

Safety Plan
Dyslexia , Anxiety and Stress: A New Zealand Study

Identified Risk: A child may become upset or distressed as a result of taking part in the study and/or at any point in the study. Children may become distressed when hearing or talking about experiences that have been frustrating or difficult. The process through which this expression of emotion is planned for and managed is important (Peled, 2001).

Actions:
A safety protocol is outlined below, which aims to enhance and encourage the researcher to be mindful of:
1. participant well-being, safety and supports.
2. the researcher's own professional safety (i.e., reputation).

Safety Protocol:
1. Immediately prior to beginning data collection, the researcher will remind any students experiencing distress that they may cease their participant and withdraw their assent verbally at any point during the data collection and up to two weeks after data collection.
2. The researcher will observe the participants closely for any visible signs of distress during whole group assessments and 1:1 assessments (e.g., sweating, crying, head in hands, upset affect, leaving the seat/room). Children's distress cues are often different from adults' cues, so awareness of children looking distracted or focusing on something else in the room may also be prompts for the researcher that the questions / test items are causing some form of distress (Powell and Smith, 2009).
3. The classroom teacher, as the familiar adult with primary pastoral care responsibilities and knowledge of his/her students, will be asked to speak with the student at the point of any distress being observed and will be reminded to inform the student that he/ she may remove his assent immediately if he/she wishes and cease participation.
4. In the absence of the classroom teacher, the researcher will comfort the student by reassuring him/her that the classroom teacher is being called upon and that he/she may put down his pen/pencil and cease the assessments immediately. A 'runner' will be sent to ask the classroom teacher to return to speak privately with the student.
5. If a guidance counsellor is available within the school, any student experiencing distress will be invited to talk with the guidance counsellor.

Appendix K. Letter to notify parents of a D-TP.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Heather Smith
(Post Graduate Researcher)
Email: masseyresearcher@gmail.com
Telephone:0211414420

Dear _____,

Your child has recently participated in a research study using classroom-based assessments to identify characteristics consistent with a dyslexic profile, anxiety levels and sources of stress. As part of your consenting to your child being involved in this project, you requested to be informed of your child's individual results.

Results
As a participant in the research project 'Dyslexia, Anxiety and Sources of Stress: A New Zealand Study', your child,___(CHILD'S NAME)'s result are consistent with a D-TP. Your child's results displayed a discrepancy between reading comprehension ability and listening comprehension ability. In other words, he/she displays an above average ability to comprehend spoken language and a lower than expected level of reading comprehension, for his/her age. Your child also scored below average (for his/her age) in a test of decoding ability, as measured by his/her performance reading nonwords.

It is important to be aware that this assessment is based on a snap-shot of your child's performance in three assessments alone and may not reflect his/her general or everyday performance. Many things, such as illness, mood, tiredness and even time of day can affect a child's performance in any assessment. Therefore, it is essential to recognise that your child's results(at the time of testing) are not definitive or diagnostic and merely are in line with characteristics that are consistent with a D-TP.

Recommendations
- You may wish to discuss these findings with your child and your child's classroom teacher.
- The New Zealand Ministry of Education website has some useful information regarding how to get support and what you can do to help if you think your child may have dyslexia: https://parents.education.govt.nz/primary-school/learning-at-school/how-to-support-a-child-with-dyslexia/
- Further information can also be found on these New Zealand websites:
  - The Dyslexia Foundation http://www.dyslexiafoundation.org.nz/
  - Speld https://www.speld.org.nz/

I would like to take this opportunity to sincerely thank you for allowing your child to be part of this study and for contributing to our understanding of dyslexia, anxiety and stress within New Zealand.

Kind Regards

Heather Smith   **Dr Jayne Jackson**   **Dr Peter Rawlins**
Post Grad Student Researcher **Supervisor**   **Co-supervisor**

Appendix L. Letter to notify parents of elevated anxiety.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

UNIVERSITY OF NEW ZEALAND

Heather Smith
(Post Graduate Researcher)
Email: masseyresearcher@gmail.com
Telephone:0211414420

Dear _____,

Your child has recently participated in a research study investigating dyslexia, anxiety levels and sources of stress. In the information sheet, I explained that we would contact you, should your child demonstrate anxiety levels in his/her responses that are indicative of elevated anxiety.

Results
As a participant in the research project 'Dyslexia and Anxiety: A New Zealand Study', (CHILD'S NAME)'s responses were indicative of elevated symptoms of anxiety. This assessment is based on your child's responses to two socio-emotional questionnaires that he/she completed. It is important to acknowledge that this result represents a snap-shot of your child's feelings and may not reflect his/her general anxiety levels. Many things, such as illness, mood, tiredness and even time of day (or test situations) can affect a child's performance in any assessment. Therefore, it is essential to recognise that this finding is not definitive or diagnostic and merely indicative of reported elevated anxiety levels, at the time of testing.

Recommendations
Everyone gets anxious, as it is a normal human response to stressful situations. However, anxiety that goes beyond normal can sometimes be problematic. You may wish to discuss these findings with your child, or your GP, if you feel that his/her anxiety is causing your child problems.

Useful Contacts
- Kids Health is funded and supported by the Ministry of Health and has excellent advice for parents/caregivers on anxiety, what you can do to help and when to seek help. https://www.kidshealth.org.nz/anxiety

- The Anxiety NZ Trust offers an anxiety helpline (24 hours a day, 7 days a week). This service is completely confidential and free of charge. 0800 269 4389 (0800 ANXIETY).

I would like to take this opportunity to sincerely thank you for allowing your child to be part of this study and for contributing to our understanding of dyslexia and anxiety within New Zealand.

Kind Regards

Heather Smith	Dr Jayne Jackson	Dr Peter Rawlins
Post Graduate Student Researcher	Supervisor	Co-supervisor
Massey University	Massey University	Massey University

Appendix M.   Permission to use the Martin and Pratt Nonword Test.

Dear Professor Martin,

My name is Heather Smith and I am currently undertaking my Master thesis in New Zealand, looking specifically at *Dyslexia, School-related Stress and Anxiety* in an 8 - 10 year old cohort.

I am using results from your non-word reading test (The Martin and Pratt Nonword Test) as one of the criteria for identifying a dyslexic-type profile, with 6 participants. While I have used six original test forms, I am writing to seek your permission for the use of the test (as the copyright sits with you) and secondly, to reproduce the test form in part, or whole, within an appendix.

I have contacted ACER and they directed me to contact you directly, as the copyright claim currently sits with you, as the author.

I look forward to hearing from you,

Warmest Regards

Heather Smith

Dear Heather,
I am happy for you to photocopy as many of the original test forms as you need and also for you to reproduce (with appropriate reference) the test form in part or whole within an appendix in your thesis (or indeed elsewhere),
Kind regards,
Frances Martin

Appendix N. Martin & Pratt Nonword Reading test record form and test item example.

The Martin and Pratt NONWORD READING TEST — FORM A

RECORD FORM

Name: _____

Sex: M/F _____ First language: _____

Language(s) (other than English) used at home: _____

Identified impairment in hearing, vision, speech, or attention? _____

Is the identified impairment corrected with aids? _____

School: _____

Year/Grade: _____ Class teacher: _____

Administrator: _____

Place of testing: _____

	Year	Month	Day
Date of testing:	__	/ __	/ __
Date of birth:	__	/ __	/ __
Chronological age:	__	/ __	/ __

Raw score (Scoring sheet):	
Standard score (Table A1):	
Percentile rank (Table A3):	
Age-equivalent score (Table A4):	

Summary and recommendations:

Martin and Pratt NONWORD READING TEST — FORM A

Basal: All begin with practice item P1.
Ceiling: End on last word of Test Book page after 8 consecutive errors.

Test book page no.	Item	Nonword representation	Phonetic representation	Response given and comment	Score (1 or 0)
5	P1	o	o		
	P2	u	u		
	P3	k	k		
	P4	m	m		
	P5	d	d		
	P6	h	b		
	P7	y	y		
7	1	ee	ee		
	2	sh	sh		
	3	wh	wb		
	4	ck	k		
	5	en	en		
	6	loff	lof		
9	7	yil	yil		
	8	juf	juf		
	9	rint	rint		
	10	dilt	dilt		
	11	kig	kig		
	12	og	og		
11	13	vot	vot		
	14	fonk	fonjk, fonk		
	15	glax	gloks		
	16	pritt	pritt		
	17	wilp	wilp		
	18	ficket	fikst, fiket		
13	19	kuch	kuch		
	20	whex	weks, wheks		
	21	bunset	bunsat, bunset		
	22	cumfiss	kumfss, kumfs		
	23	wrapple	rapol		
	24	drost	drost		
15	25	theld	theld		
	26	rake	rook		
	27	durfs	derfs		
	28	mishplex	mishpleks		
	29	frue	froo		
	30	croid	kroid		
17	31	sotlet	sodlet, sotlet		
	32	subzaut	subzort		
	33	oiz	oiz		
	34	cinsed	sinsed, sinst		
	35	skerdeeas	skerdeeas		
	36	epichep	epeechep		
19	37	flooshed	floosht, flausht		
	38	styps	stips, stieps		
	39	breedont	breedant, breedont		
	40	thwarsh	thwoorsh		
	41	corarcy	korasee, korarsee, kazarsee*		
	42	puldly	puldlee		
21	43	fropse	frops		
	44	nur	nur		
	45	veigh	vae		
	46	swegion	swaejon, swejon		
	47	freylent	fraelont		
	48	cidgy	sijee		
23	49	shribe	shrieb		
	50	fortal	forsbol		
	51	glaight	glaet		
	52	choolsta	choolseea, choolseeu		
	53	sheelbz	sheelbz		
	54	neopth	neeopth		
				Raw score	

* Item is pronounced with emphasis on /oi/

vot   fonk   glax

prilt   wilp   ficket

Appendix O. Permission for reproduction of SCAS questionnaire

-----Original Message-----
From: heather smith <heathermaysmith@hotmail.com>
Sent: Monday, 21 October 2019 10:34 AM
To: Sue Spence <███████████████>
Subject: SCAS permission

Dear Dr Spence,
I have used your SCAS questionnaire for a research project, here in New Zealand, for my Master's Thesis,
which examined Anxiety in students with a dyslexic-type profile.
I am wondering if I might have your permission to appendix the questionnaire in its entirety in my final
thesis?
Many thanks for your consideration,
Yours kindly,
Heather Smith

Dear Heather,
Yes, that is fine to put a copy in the thesis, just not in actual publications.
Well done on finishing the study.
Kind regards
Sue

Appendix P. SCAS questionnaire (all items)

.

SPENCE CHILDRENS ANXIETY SCALE

Your Name: _____   Date:_____

PLEASE PUT A CIRCLE AROUND THE WORD THAT SHOWS HOW OFTEN EACH OF THESE THINGS HAPPEN TO YOU. THERE ARE NO RIGHT OR WRONG ANSWERS.

1. I worry about things...Never Sometimes Often Always
2. I am scared of the dark..Never Sometimes Often Always
3. When I have a problem, I get a funny feeling in my stomach...............Never Sometimes Often Always
4. I feel afraid..Never Sometimes Often Always
5. I would feel afraid of being on my own at home...................................Never Sometimes Often Always
6. I feel scared when I have to take a test..Never Sometimes Often Always
7. I feel afraid if I have to use public toilets or bathrooms.......................Never Sometimes Often Always
8. I worry about being away from my parents..Never Sometimes Often Always
9. I feel afraid that I will make a fool of myself in front of people............Never Sometimes Often Always
10. I worry that I will do badly at my school work.....................................Never Sometimes Often Always
11. I am popular amongst other kids my own age......................................Never Sometimes Often Always
12. I worry that something awful will happen to someone in my family ....Never Sometimes Often Always
13. I suddenly feel as if I can't breathe when there is no reason for this.................Never Sometimes Often Always
14. I have to keep checking that I have done things right (like the switch
    is off, or the door is locked) ....Never Sometimes Often Always
15. I feel scared if I have to sleep on my own..Never Sometimes Often Always
16. I have trouble going to school in the mornings because I feel nervous
    or afraid...Never Sometimes Often Always
17. I am good at sports..Never Sometimes Often Always
18. I am scared of dogs..Never Sometimes Often Always
19. I can't seem to get bad or silly thoughts out of my head.....................Never Sometimes Often Always
20. When I have a problem, my heart beats really fast...............................Never Sometimes Often Always
21. I suddenly start to tremble or shake when there is no reason for this.............Never Sometimes Often Always
22. I worry that something bad will happen to me.....................................Never Sometimes Often Always
23. I am scared of going to the doctors or dentists....................................Never Sometimes Often Always
24. When I have a problem, I feel shaky...Never Sometimes Often Always
25. I am scared of being in high places or lifts (elevators)...........................Never Sometimes Often Always
26. I am a good person...Never Sometimes Often Always
27. I have to think of special thoughts to stop bad things from happening
    (like numbers or words) ....Never Sometimes Often Always
28 I feel scared if I have to travel in the car, or on a Bus or a train............Never Sometimes Often Always
29. I worry what other people think of me..Never Sometimes Often Always
30. I am afraid of being in crowded places (like shopping centres, the
    movies, buses, busy playgrounds) ....Never Sometimes Often Always
31. I feel happy...Never Sometimes Often Always
32. All of a sudden I feel really scared for no reason at all.........................Never Sometimes Often Always
33. I am scared of insects or spiders...Never Sometimes Often Always
34. I suddenly become dizzy or faint when there is no reason for this..........Never Sometimes Often Always
35. I feel afraid if I have to talk in front of my class ....Never Sometimes Often Always
36. My heart suddenly starts to beat too quickly for no reason..................Never Sometimes Often Always
37. I worry that I will suddenly get a scared feeling when there is nothing
    to be afraid of...Never Sometimes Often Always
38. I like myself...Never Sometimes Often Always
39. I am afraid of being in small closed places, like tunnels or small rooms............Never Sometimes Often Always
40. I have to do some things over and over again (like washing my hands,
    cleaning or putting things in a certain order) ....Never Sometimes Often Always
41. I get bothered by bad or silly thoughts or pictures in my mind.............Never Sometimes Often Always
42. I have to do some things in just the right way to stop bad things
    happening...Never Sometimes Often Always
43. I am proud of my school work..Never Sometimes Often Always
44. I would feel scared if I had to stay away from home overnight.............Never Sometimes Often Always

THE END

Appendix Q. The School Situational Survey (some items)

School Situation Survey

Name: _____   **Gender:** Male/Female (circle one)
School: _____
Year group: _____

A number of statements that students can use to describe themselves are listed. Please listen to each statement, as it is read aloud and decide how often it seems to describe you. For each statement, circle the appropriate answer, using the following choices:

1 = Never   2 = Rarely   3 = Sometimes   4 = Often   5 = Always

There are no right or wrong answers. Remember, choose the response that best describes you.

		Never	Rarely	Sometimes	Often	Always
1	I enjoy doing things with my classmates	1	2	3	4	5
2	I feel that some of my teachers don't like me very much	1	2	3	4	5
3	I get into fights	1	2	3	4	5
4	I feel upset	1	2	3	4	5
5	I worry about not doing well in school	1	2	3	4	5
6	I get headaches	1	2	3	4	5
7	I do well in school and get good scores	1	2	3	4	5
8	Other students make fun of me	1	2	3	4	5
9	I feel that some of my teachers expect too much of me	1	2	3	4	5
10	I talk in class when I should be quiet	1	2	3	4	5
11	I feel mixed up	1	2	3	4	5
12	I get along with my classmates	1	2	3	4	5
13	Some of my teachers call on me when they know I am not prepared just to embarrass me	1	2	3	4	5
14	I pick on other students	1	2	3	4	5
15	I feel frustrated	1	2	3	4	5
16	I am afraid of getting low scores	1	2	3	4	5
17	I feel sick to my stomache	1	2	3	4	5
18	I feel that I learn things easily	1	2	3	4	5
19	I am among the last to be chosen for teams	1	2	3	4	5
20	I feel that some of my teachers don't really care about what I think or how I feel	1	2	3	4	5
21	I yell at my classmates	1	2	3	4	5
22	I feel like crying	1	2	3	4	5
23	I enjoy talking to my classmates	1	2	3	4	5
24	I feel that my teachers treat me fairly	1	2	3	4	5
25	I talk back to my teachers	1	2	3	4	5
26	I feel nervous	1	2	3	4	5
27	I worry about taking tests	1	2	3	4	5
28	I get stomach aches	1	2	3	4	5
29	I do good work in school	1	2	3	4	5

Appendix R. Histograms and Q-Q plots for SCAS anxiety dimensions (whole sample)
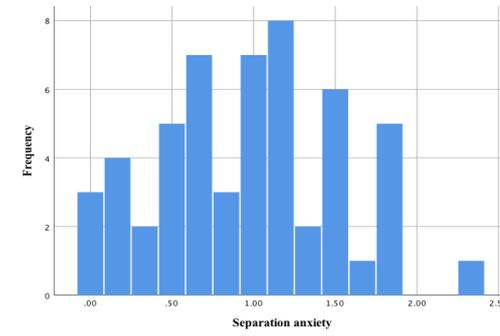
Figure R-1. Histogram distribution of separation anxiety
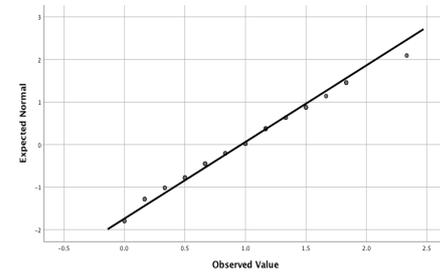
Figure R-2. Q-Q plot for separation anxiety
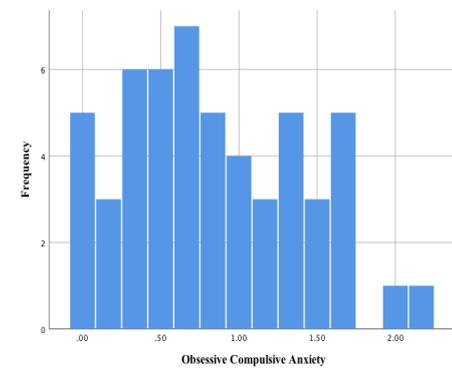
Figure R-3. Distribution of obsessive-compulsive anxiety
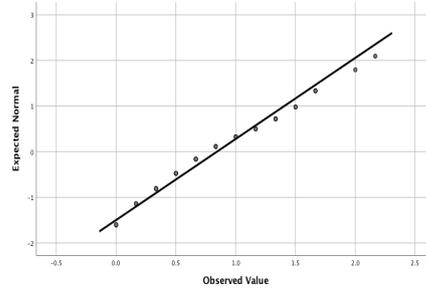
Figure R-4. Q-Q plot for obsessive-compulsive anxiety
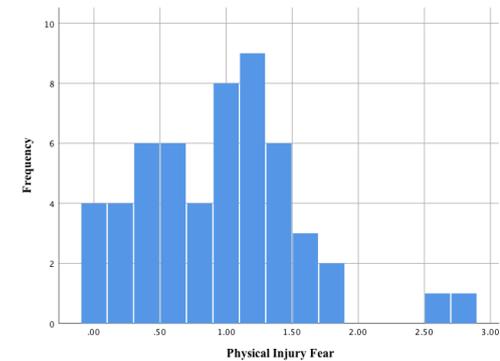
Figure R-5. Distribution of physical Injury Fear
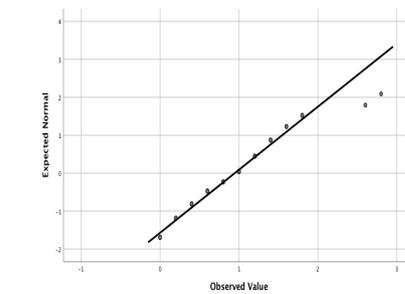
Figure R-6 . Q-Q plot for Physical injury fear
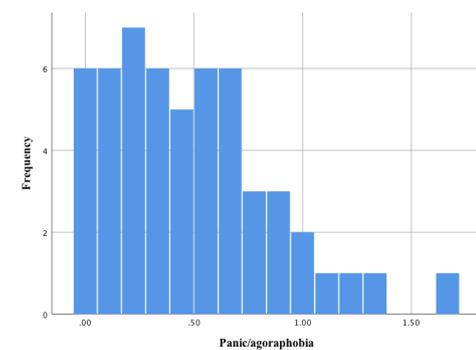
Figure R-7. Distribution of Panic-agoraphobia
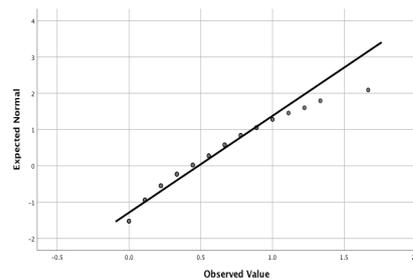
Figure R-8. Q-Q Plot of Panic Agoraphobia
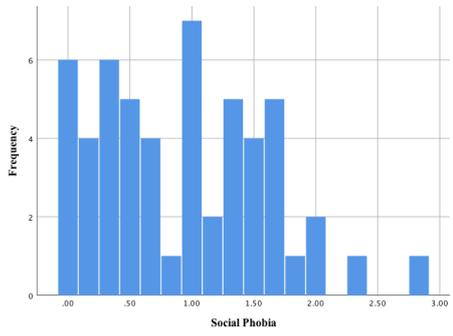
Figure R-9. Distribution of social phobia anxiety   *Figure R-10.* Q-Q plot for social phobia anxiety   R
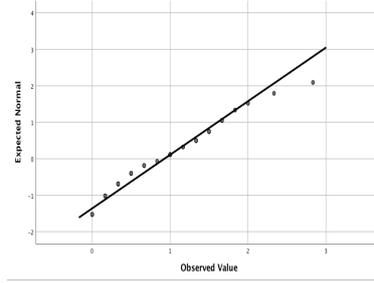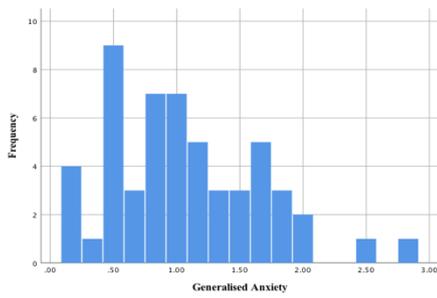
Figure R-11. Distribution of Generalise anxiety scores   *Figure R-12.* Q-Q plot of generalised anxiety
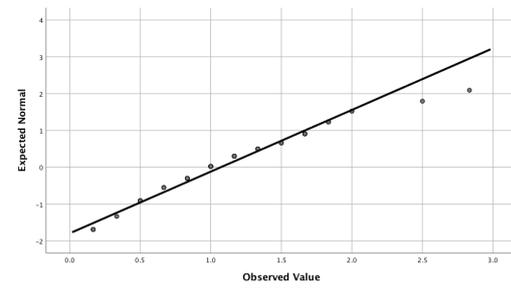
Appendix S. Box Plots for anxiety dimension scores for entire sample
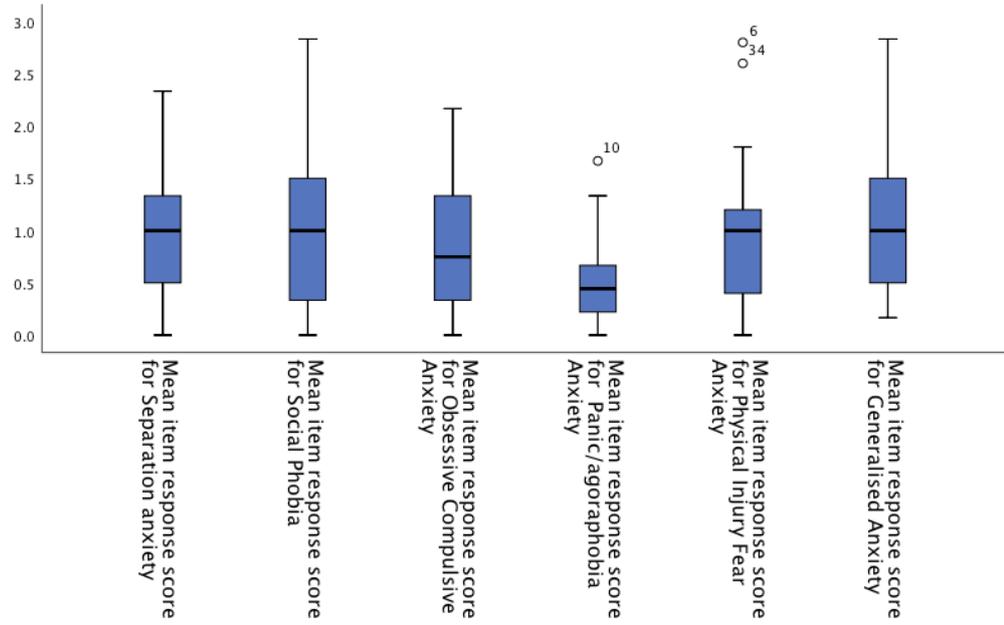
Figure S-1. Box plots for sample scores on the anxiety subscales

Appendix T. Scatterplot matrices for anxiety dimension scores

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Reading Group
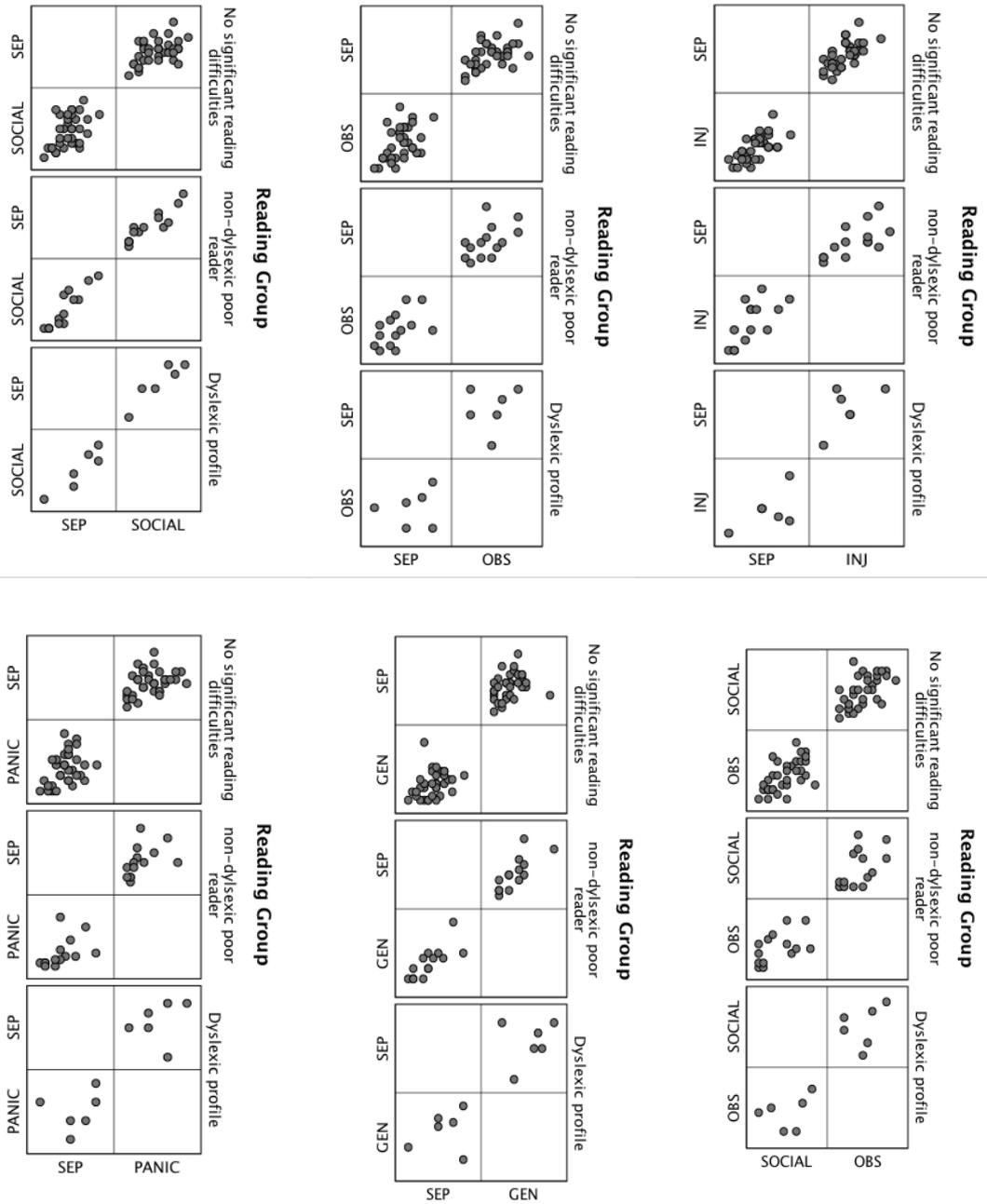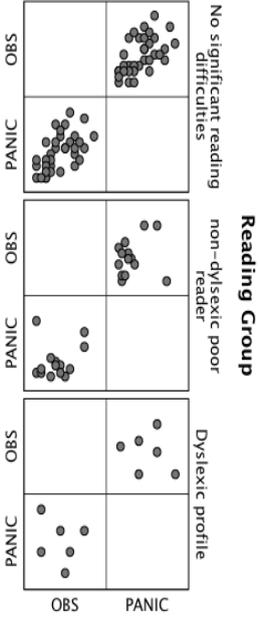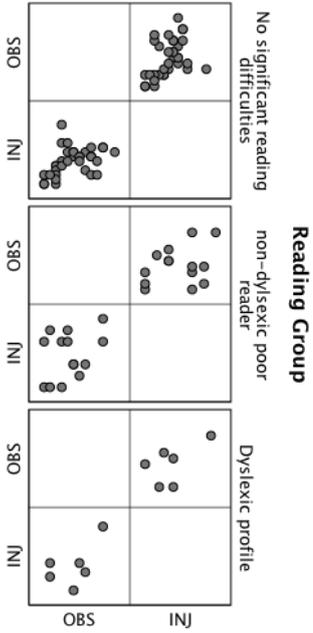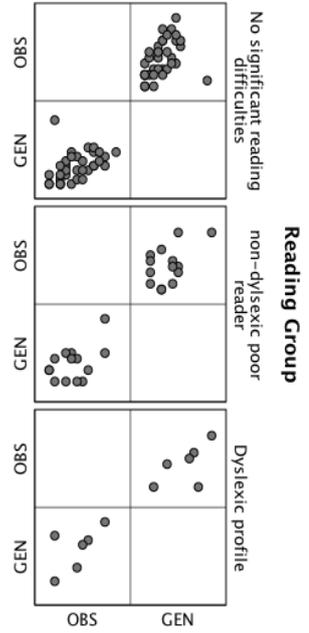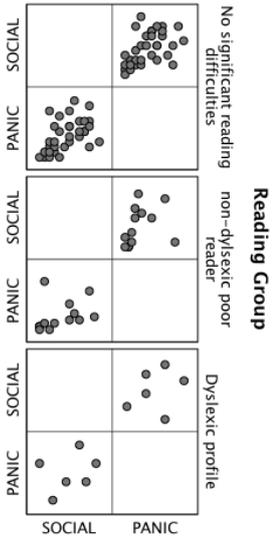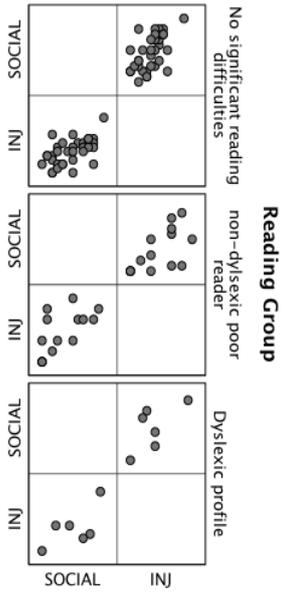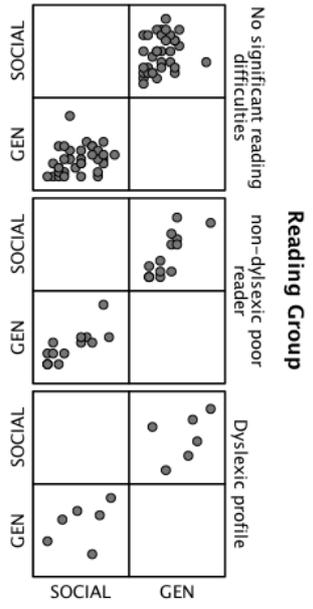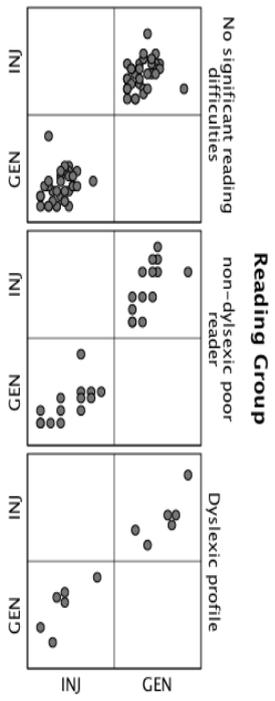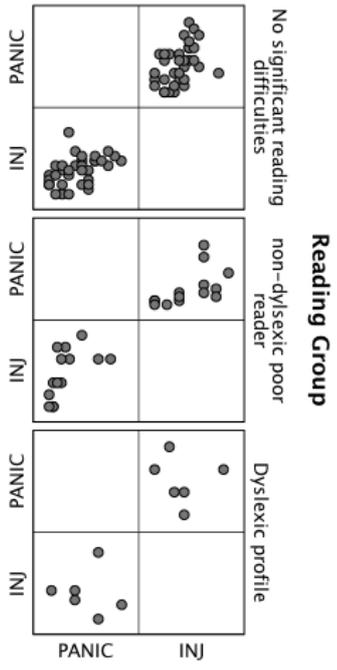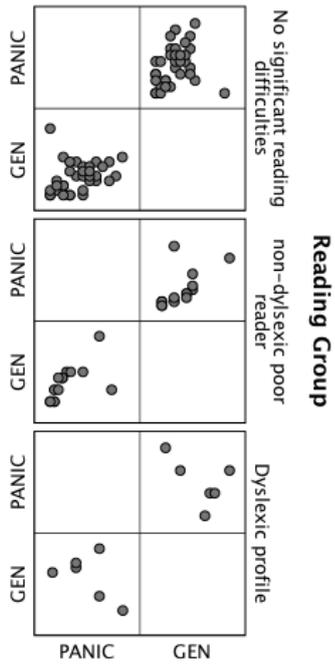
Appendix U. Histograms, Q-Q Plots and Box Plots for sources of stress (whole sample)
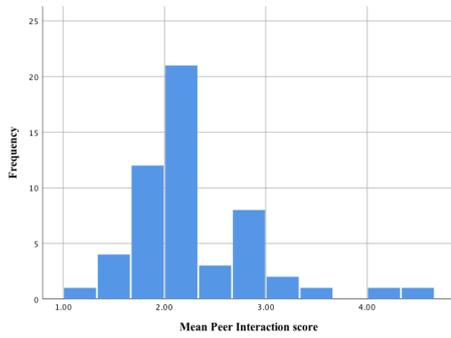
Figure U-1. Distribution of Peer Interaction stress
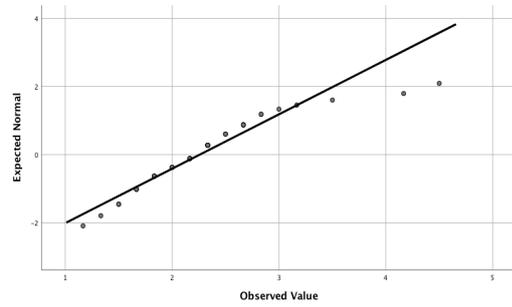
Figure U-2. Q-Q plot of Peer Interaction stress
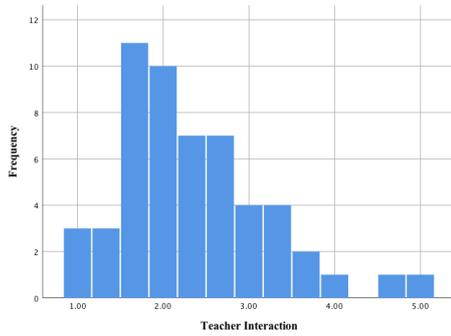
Figure U-3. Distribution of teacher interaction stress
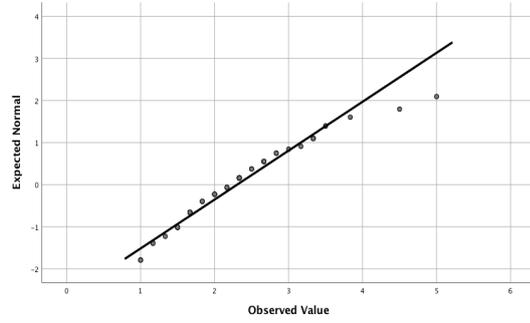
Figure U-4. Q-Q Plot of Teacher Interaction stress
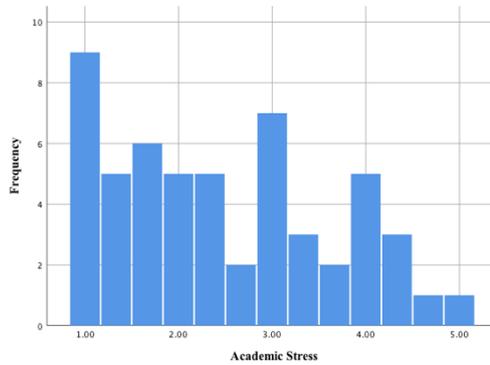
Figure U-5. Distribution of Academic stress
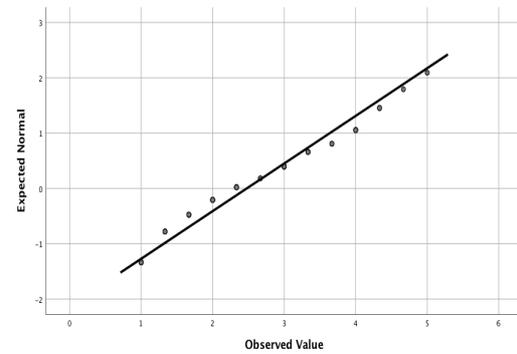
Figure U-6 . Q-Q Plot of Academic stress
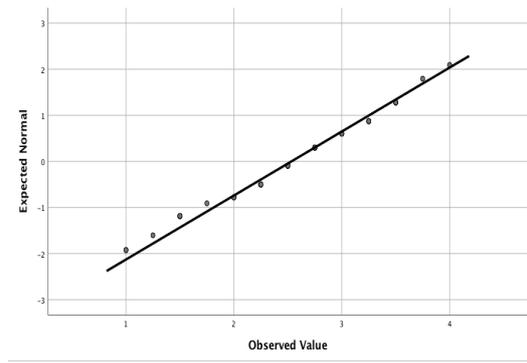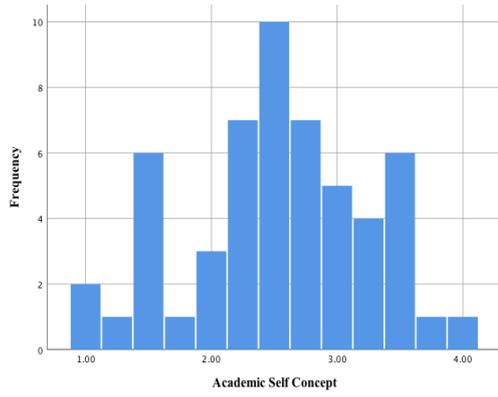
Figure U-7. Distribution of Academic self-concept stress   *Figure U-8.* Q-Q plot of Academic self-concept stress
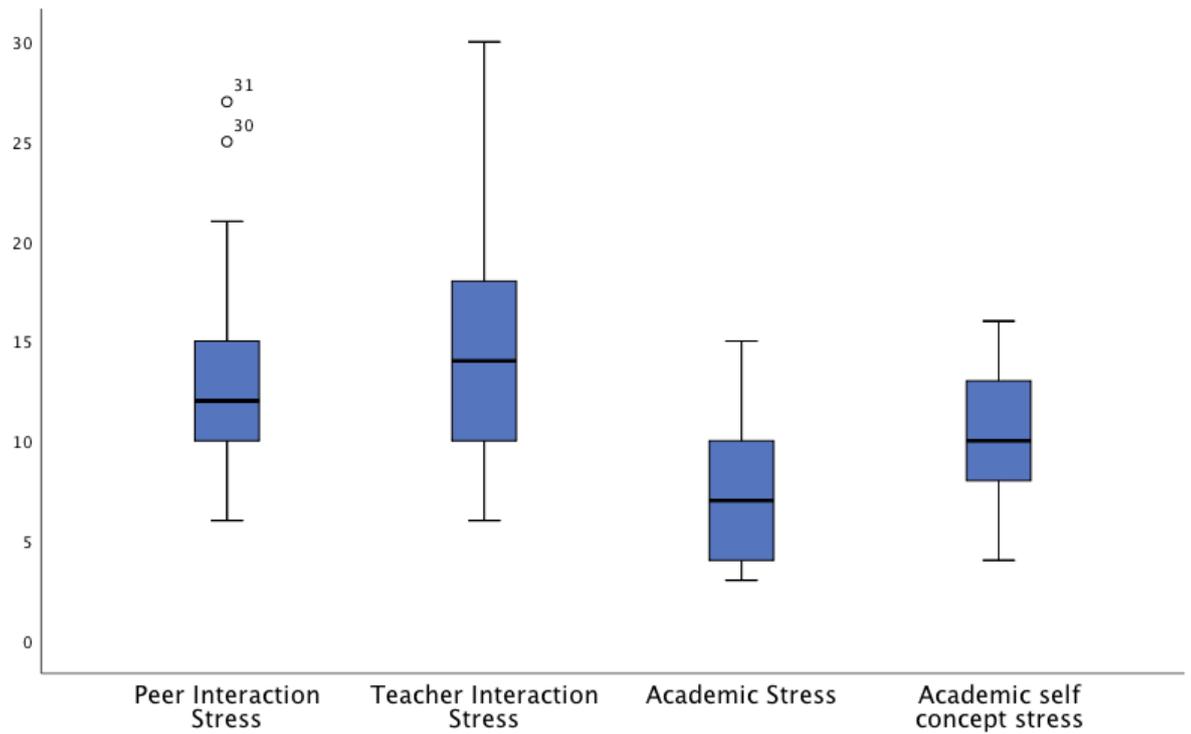
Figure U-9. Boxplots for whole sample scores across stress source subscales

Appendix V. Histograms, Q-Q Plots and box plots for Manifestations of Stress (whole sample)
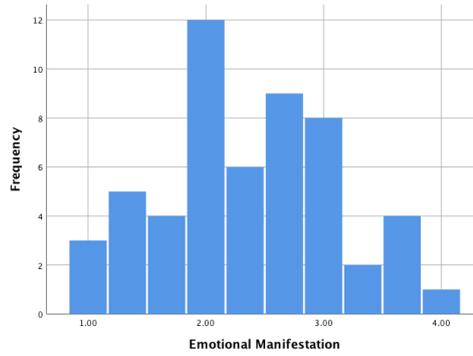
Figure V-1. Distribution of Emotional Manifestation
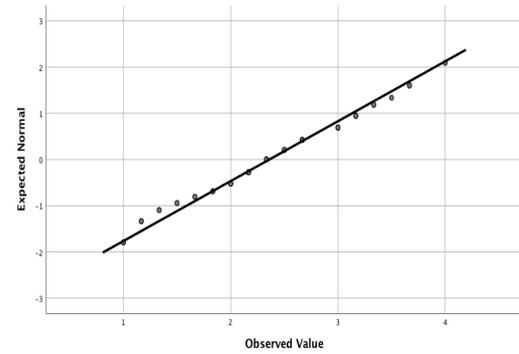
F*igure V-2.* Q-Q plot of Emotional Manifestation
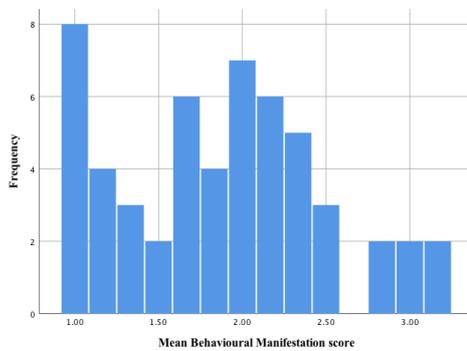
Figure V-3. Distribution of Behavioural Manifestation
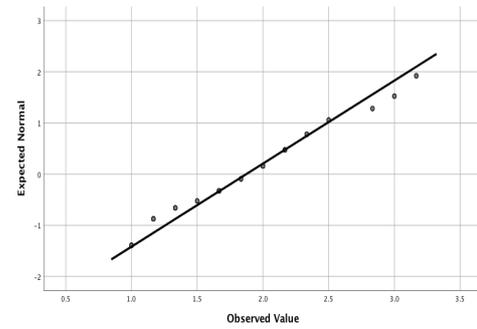
Figure V-4. Q-Q plot of Behavioural manifestations
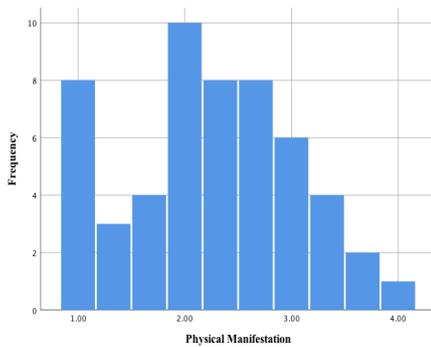
Figure V-5. Distribution of Physical Manifestations of stress
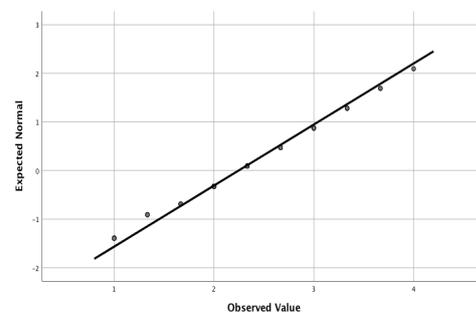
Figure V-6. Q-Q plot for Physical Manifestations
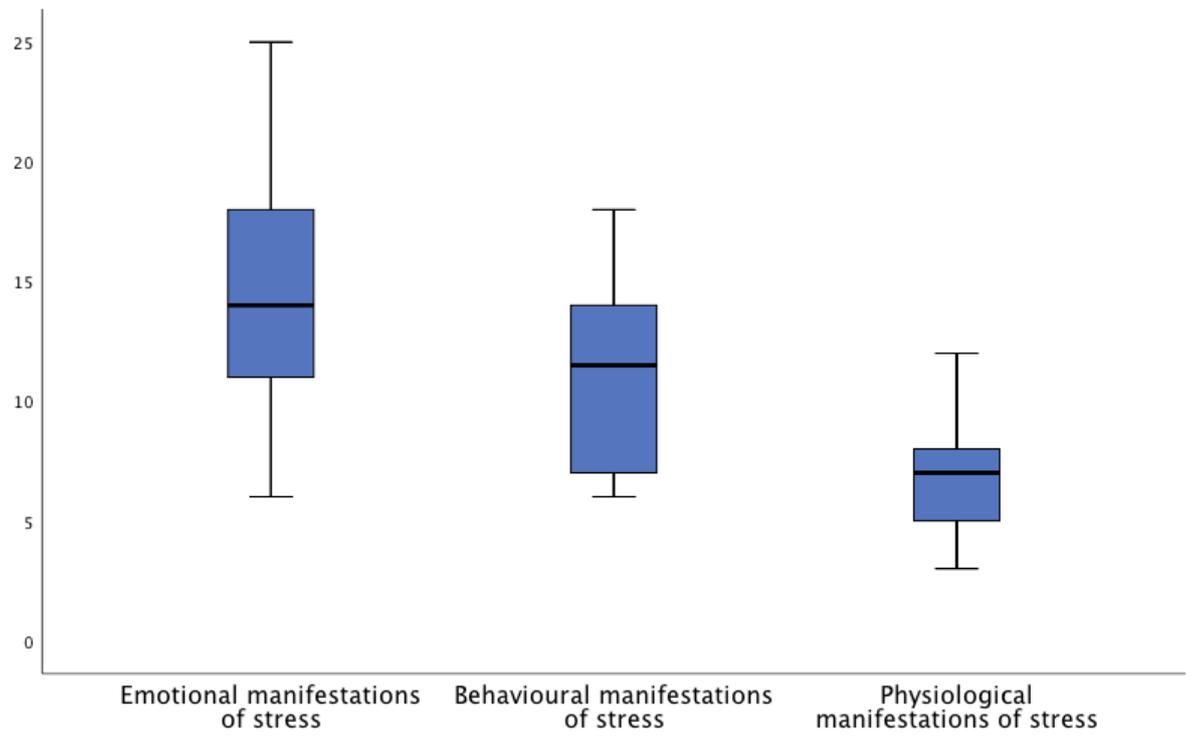
Figure V-7. Boxplots for manifestations of stress scores across all participants

.

Appendix W. Key Assumptions to be met for MANOVA and t-test analysis

Table W-1. *Assumptions for running MANOVAS and t-test analysis*

	Assumptions for running multivariate analysis of variance		Assumptions for running T-test analysis
1.	There are two or more dependent variables are measured at the continuous level.	1.	The collected data should follow a continuous or ordinal scale
2.	There is one independent variable that consists of two or more categorical, independent groups.	2.	One independent variable that consists of two independent groups.
3.	There should be independence of observations.	3.	Independence of observations.
4.	There should be no univariate outliers in each reading group, for any of the anxiety subscales.	4.	There should be no significant outliers within each group.
5.	There should be multivariate normality.	5.	The dependent variable should be approximately normally distributed.
6.	There should be no multicollinearity.	6.	There should be homogeneity of variance.
7.	There should be a linear relationship between the dependent variables for each group of the independent variable.		
8.	There should be an adequate sample size.		
9.	There should be homogeneity of variances-covariance matrices.		
10	There should be homogeneity of variances.		

Appendix X. Assumptions testing before statistical analysis of anxiety group differences.

Manova assumption testing

The assumptions that must be satisfied for the MANOVA analyses were identified from Laerd Statistics (2015), and assumption checking was carried out as follows:

1. **There are two or more dependent variables are measured at the continuous level.**

    The assumption that the dependent variables (six anxiety subscales; the four stress source scores and the three stress manifestation scores) are measured at the interval level (i.e., they are continuous) was considered to be met. While *Likert-type* items would fall clearly into the ordinal scale category, it is argued that the *Likert-scale* data from the SCAS can be analysed at the interval level. Lubke & Muthen (2004) found that it is possible to find true parameter values in factor analysis with Likert scale data (Lubke & Muthen, 2004) and for F-tests to return accurate p-values on Likert items (Glass et al, 1972), if the assumption of *normal distribution* is met. The ability to calculate a composite score for subscales within each scale, using four or more items, can allow us to treat this data as interval (Boone & Boone, 2012). We can also evoke the central limit theorem and suggest that the number of items should be sufficient to treat the subscales as interval data. Secondly, when examining the distribution of anxiety subscale results for the sample (Appendix R, V & U) we can see that the results did not depart significantly from normality. Finally, the Bonferroni adjustment (with associated lower alpha levels) will allow clearer results in the presence of any potential parameter estimate bias. Therefore, while the researcher acknowledges that Likert scale responses typically fall into the ordinal category, for the reasons stated, the derived mean scores for the subscales were treated and analysed as interval level data, for the purposes of this study, and this assumption was met.

2. **There is one independent variable that consists of two or more categorical, independent groups.** In this study the independent variable is the reading group, of which there are three groups, therefore this assumption was met.

3. **There should be independence of observations.** This assumption requires there to be no relationship between the groups. This assumption was met by each group having different participants.

4. **There should be no univariate outliers in each reading group, for any of the anxiety subscales.**

According to boxplots (Figures X1-X6), there was one outlier (different participants) in four out of the six subscales. One *no significant reading difficulties* outlier was found in *separation anxiety* (*Participant ID* 49); one generic poor reader outlier (*Participant ID* 10) was found in *panic-agoraphobia*; one outlier from the *D-TP* group (*Participant ID* 6) was found in *physical injury* fear and one outlier was found in *generalised* anxiety (*Participant ID* 52) from the *no significant reading difficulties* group. As these few outliers had scores between 0 – 3, in the range of all anxiety subscale scores, they were not excluded from the study. Therefore, assumption of no univariate outliers was assumed to be met.
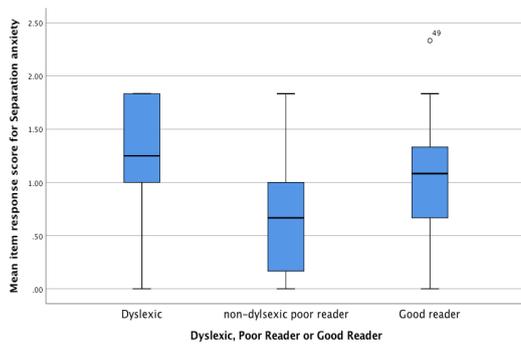
Figure X-1. Boxplots for separation anxiety scores.
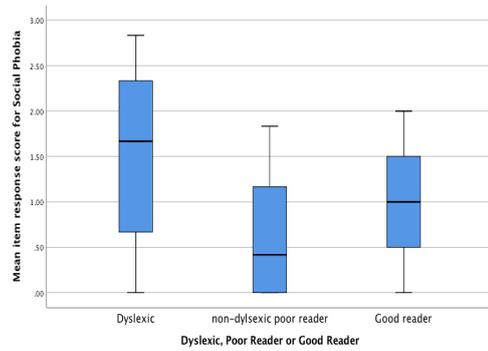
Figure X-2. Boxplots for Social Phobia anxiety scores.
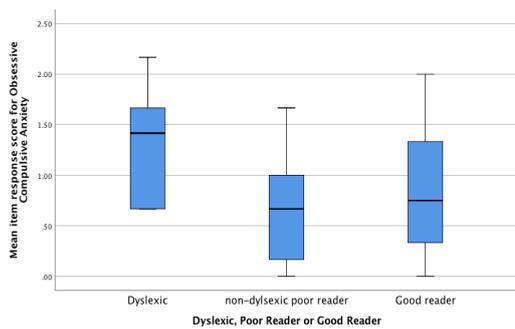
Figure X-3. Boxplots for Obsessive-compulsive anxiety.
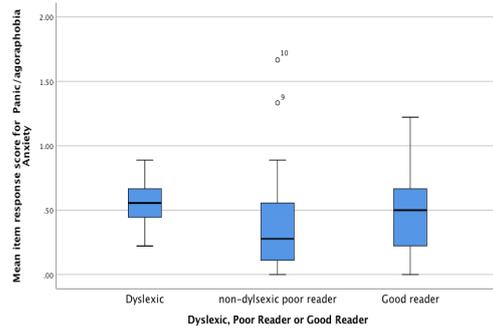
Figure X-4. Boxplots for Panic-agoraphobia anxiety.

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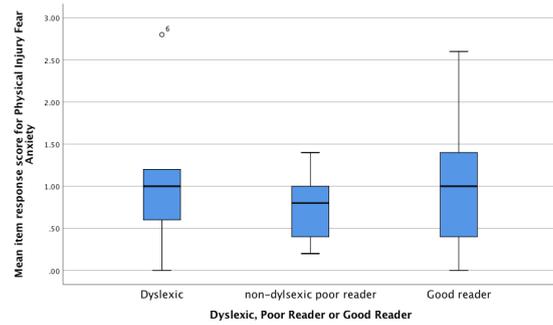
Figure X-5. Boxplots for Physical Injury anxiety scores. scores
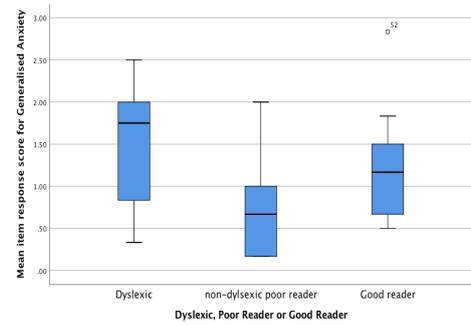
Figure X-6. Boxplots for Generalised anxiety

Further testing was carried out for multivariate outliers by calculating Mahalanobis distances. Analysis with participant ID as the dependent variable and the anxiety dimensions as the independent variables, revealed maximum Mahalanobis distance of 22.9. According to Pearson and Hartley (1966), the critical value of Mahalanobis distance for the model with six independent variables is 22.46. Only one participant revealed a Mahalanobis distance higher than the critical value. While the maximum Mahalanobis was just out-with the recommended critical value, Cook's distance was revealed to be .252, which was much below the recommended critical value of 1.00 (Tabachnick & Fidell, 2007). Therefore the participant was not removed from the study and the assumption of no multivariate outliers was not considered to be violated.

5. **There should be multivariate normality.**

Normality of each of the dependent variables (the anxiety scales scores) is used to show that this assumption has been met. Therefore, normality of each dependent variable for each of the groups was carried out to test for best-estimate of multivariate normality (see Table X-1), by calculating standardised skewness and kurtosis, running Kolmogorov-Smirnov and Shapiro-Wilk normality tests, drawing histograms and box-plots with outliers. The values for asymmetry and kurtosis between -2 and +2 were considered acceptable in order to prove normal univariate distribution (George & Mallery, 2010). Standardised skewness and kurtosis values for anxiety dimensions at group level were within the (-2, +2) range for all anxiety dimensions at all reading group levels, except for *panic-agoraphobia* in the generic poor reader group and *generalised anxiety* for the generic poor readers and readers with no significant reading difficulties

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(Table X-1). However, histogram distributions did not reveal large deviations from normality (Figures X-7 – X-9).

Table X-1.

Normality measures of anxiety dimensions for each reading group and normality test significance.

Anxiety Dimension	Reading Group	Normality measure	Statistic	Std. Error	Standardised	Shapiro-Wilk *p*-value
Separation	D-TP	*Skewness*	-1.046	.845	-1.238	.269
		Kurtosis	.910	1.741	.523	
	Generic poor readers	*Skewness*	.751	.597	1.258	.364
		Kurtosis	.121	1.154	.105	
	No sig. reading difficulties	*Skewness*	.190	.403	.471	.844
		Kurtosis	1.528	.788	1.94	
Social Phobia	D-TP	*Skewness*	-.336	.845	-.398	.888
		Kurtosis	-1.182	1.741	-.679	
	Generic poor readers	*Skewness*	.561	.597	.949	.038
		Kurtosis	-1.194	1.154	-1.035	
	No sig. reading difficulties	*Skewness*	.118	.403	.293	.075
		Kurtosis	-1.214	.788	-1.540	
Obsessive-compulsive	D-TP	*Skewness*	.041	.845	0.049	.517
		Kurtosis	-.996	1.741	-.572	
	Generic poor readers	*Skewness*	.506	.597	.848	.299
		Kurtosis	-.426	1.154	-.369	
	No sig. reading difficulties	*Skewness*	.322	.403	.799	.183
		Kurtosis	-.804	.788	-1.020	
Physical injury fear	D-TP	*Skewness*	1.22	.845	1.444	.377
		Kurtosis	2.448	1.741	1.429	
	Generic poor readers	*Skewness*	-.104	.597	-.174	.142
		Kurtosis	-1.353	1.154	-1.172	
	No sig. reading difficulties	*Skewness*	.240	.403	.596	.276
		Kurtosis	.132	.788	.168	
Panic-agoraphobia	D-TP	*Skewness*	.000	.845	0	.820
		Kurtosis	-.248	1.741	-.142	
	Generic poor readers	*Skewness*	1.531	.597	2.565	.006
		Kurtosis	1.600	1.154	1.386	
	No sig. reading difficulties	*Skewness*	.334	.403	.829	.194
		Kurtosis	-.665	.788	-.844	
Generalised anxiety	D-TP	*Skewness*	-.579	.845	-.685	.692
		Kurtosis	-.711	1.741	-.408	
	Generic poor readers	*Skewness*	1.243	.597	2.082	.023
		Kurtosis	2.493	1.154	2.160	
	No sig. reading difficulties	*Skewness*	.935	.403	2.320	.012
		Kurtosis	1.726	.788	2.190	

N=54
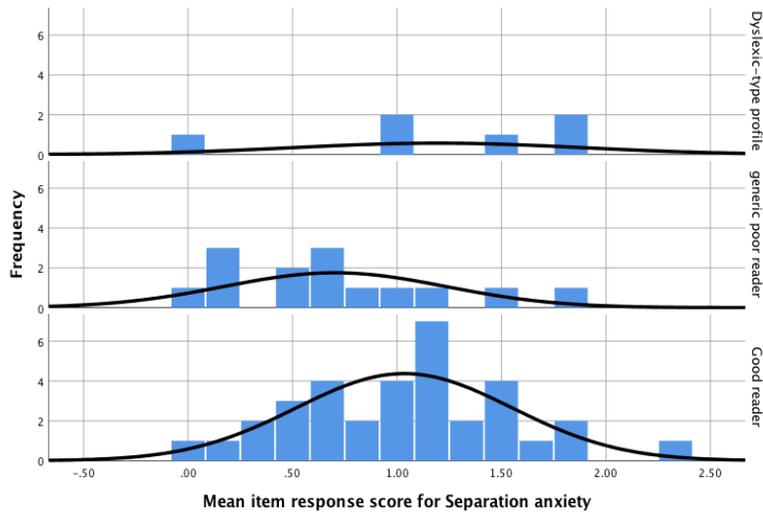
Figure X-7. Distribution of separation anxiety responses across groups
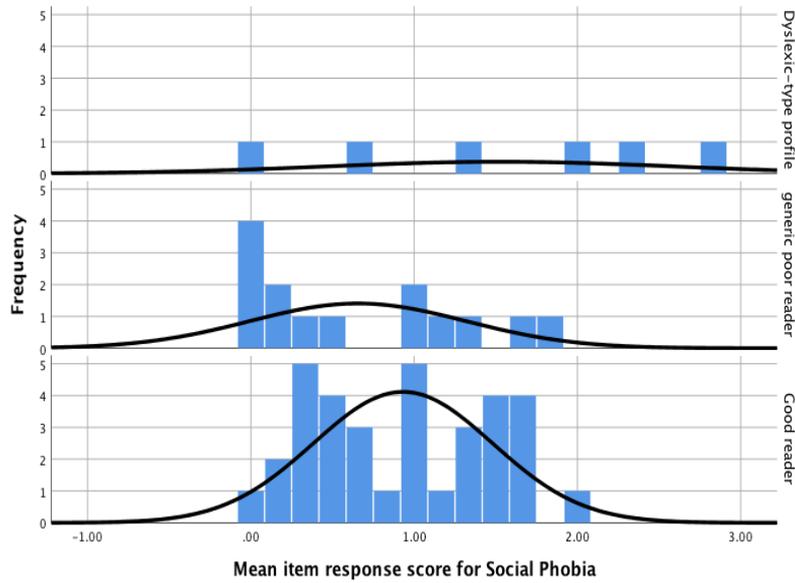
Figure X-8. Distribution of social phobia anxiety across groups
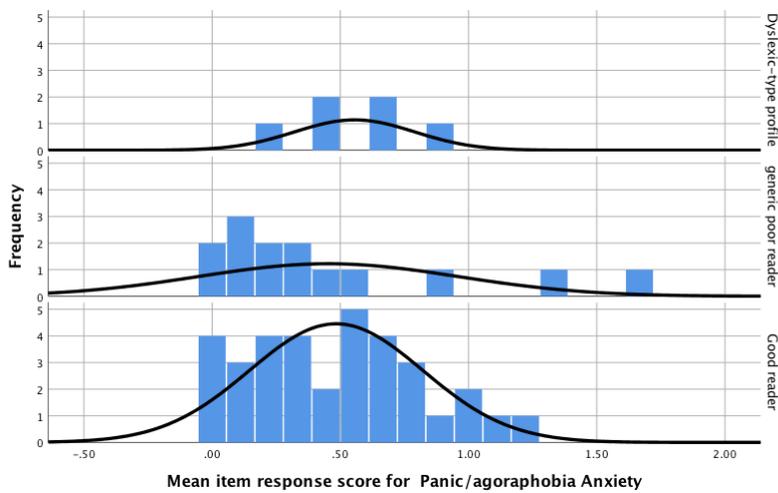
Figure X-9. Distribution of Panic Agoraphobia scores across groups
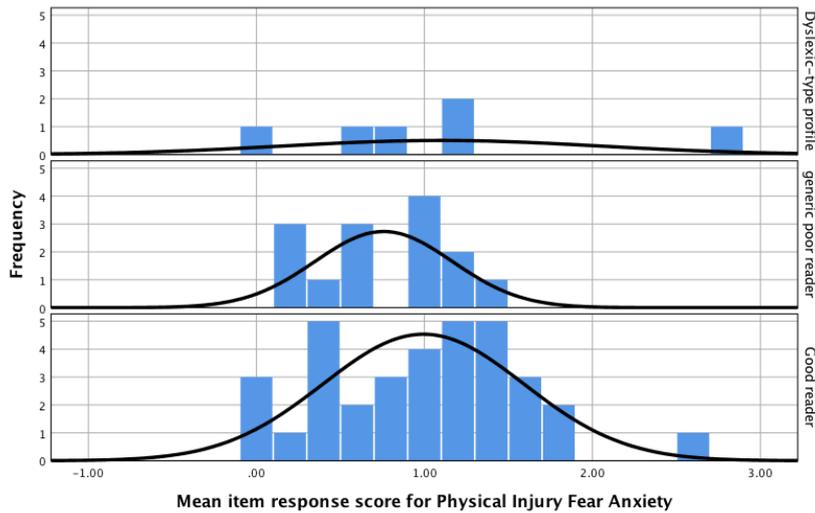
Figure X-10. Distribution of Physical Injury Fear anxiety across groups
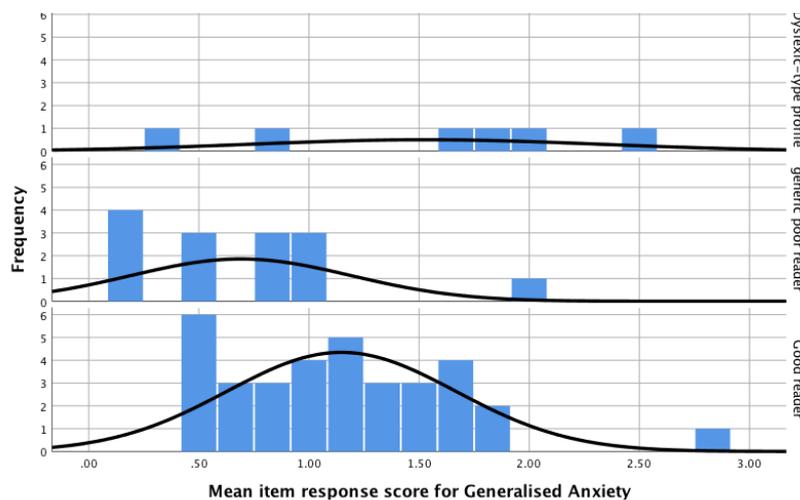
Figure X-11. Distribution of generalised anxiety scores across groups

6. **There should be no multicollinearity.** Multicollinearity and singularity were calculated using Pearson correlation coefficients among dependent variables; correlations should not be too low, and not too high. A series of Pearson correlations were performed between the six anxiety variables in order to test the MANOVA assumption that the dependent variables would be correlated with each other in the moderate range and to exclude the possibility that the correlations are too high (>0.9), which would indicate multicollinearity. As the variables were correlated in the moderate range and there were no very high intercorrelations (>.90) among the six subscales of anxiety (Results Chapter, Table 6), the assumption of multicollinearity/ singularity was not violated, suggesting a MANOVA to be appropriate.

7. **There should be a linear relationship between the dependent variables for each group of the independent variable.** The Linear relationship between dependent variables in each category of independent variable was tested by drawing scatterplot matrices. The assumption of linear relationships among dependent anxiety variables in a multivariate model, was met for each pair of the variables according to the scatter diagrams(see Appendix T).

8. **There should be an adequate sample size.** The sample size was tested, as more participants are required per cell than the number of dependent variables, for the sample size to be considered adequate. The assumption of sample size was not fully violated, as the number of participants in the smallest group (*D-TP*) was equal to, but not smaller than, the number of dependent variables (i.e., chapter six: Table 5.) and the remaining two groups had numbers greater than the number of dependent variables.

9. **There should be homogeneity of variances-covariance matrices and homogeneity of variances.** Box's M value of 35.33 ($p<.005$) was interpreted as non-significant, allowing the assumption to be met that the covariance matrices between the groups were equal, for the purposes of MANOVA. An additional check of the diagonals of the covariance matrices was carried out to ensure that the assumption of equality of error variances was met. With the Levene's test of equality of error variances, the significance values were greater than 0.10 for all of the anxiety dimensions, with the exception of *social phobia*, which displayed a significance value of 0.016. Therefore, the significance threshold was set to a stricter level for *social phobia* for the between subject analysis, following the initial MANOVA.

T-test assumption testing

The assumptions that must be satisfied for a t-test analysis were identified from Laerd Statistics (2015), as outlined below. Some of the required assumption checking has already been carried out in relation to the multivariate assumptions and will be stated as such. Otherwise, assumption checking was carried out as follows:

1. **The collected data should follow a continuous or ordinal scale.** Assumption is met (as outlined in assumption (1) of the multivariate assumption testing)

2. **One independent variable that consists of two independent groups**. This assumption is met, as the reading groups (i.e., the independent variables) that are being compared, are independent groups.

3. **Independence of observations.** This assumption requires there to be no relationship between the groups. This assumption was met by each group having different participants.

4. **There should be no significant outliers within each group.** In terms of the dependent variables, there should be no especially high or low scores within each group. This was already assessed for the multivariate analysis assumptions, via boxplots for each groups' scores on each of the six anxiety dimensions (see assumption (4) testing for the multivariate analysis). As before, the few outliers were not excluded from the study, as they had scores between $0 - 3$, in the range of all anxiety subscale scores.

5. **The dependent variable should be approximately normally distributed.** Shapiro-Wilk normality statistics were already run for the multivariate analysis and were significant (P<.05) for all anxiety dimensions, except *separation anxiety* and *obsessive-compulsive* anxiety. Histograms indicate distributions that are close to normal and Q-Q plots indicated close to normal linearity (Figures R1- R12). Despite the Shapiro-Wilk's test results not demonstrating normality for *separation* and *obsessive-compulsive* anxiety, it was decided to run the test anyhow, as the independent-samples t-test is reasonably robust to normality deviations.

6. **The assumption of homogeneity of variance**. This assumption states that the variance must be equal in each group of the independent variables. Equal variance exists when the standard deviations of samples are approximately equal. The assumption of homogeneity of variances was met, as assessed by Levene's test for equality of variances, with significance values being greater than 0.10 for all of the anxiety dimensions, with the exception of *social phobia*, when comparing the D-TP group scores with the no significant reading difficulties group scores. As this assumption was violated, the independent-samples t-test comparing these two groups for social phobia was calculated using separate variance.

Appendix Y. Assumption testing before statistical analysis of stress source group differences.

Manova assumption testing

The assumptions that must be satisfied for a MANOVA analysis were identified from Laerd Statistics (2015), and assumption checking was carried out as follows:

1. **There are two or more dependent variables and they are measured at the continuous level.**

The assumption that the four dependent variables are measured at the interval level (i.e., they are continuous) was considered to be met (see Appendix X for discussion on Likert Scale data).

2. **There is one independent variable that consists of two or more categorical, independent groups.**

In this study the independent variable is the reading group, of which there are three groups, therefore this assumption was met.

3. **There should be independence of observations.**

This assumption requires there to be no relationship between the groups. This assumption was met by each group having different participants.

4. **There should be no univariate outliers in each reading group, for any of the stress subscales.**

Two outliers were revealed from examination of the boxplots (Figures Y1 -Y4): Participant ID 31 was an outlier for *teacher interactions* and *peer interactions* and belonged to the group with no significant reading difficulties. Participant ID 15 was an outlier in *academic self-concept* and belonged to the generic poor reading group. These two participants were not excluded from the study due to small sample size and the fact that they still gained scores in the range of $0 - 3$ for the sources of stress dimensions. Overall, the assumption of no univariate outliers was therefore assumed to be met.
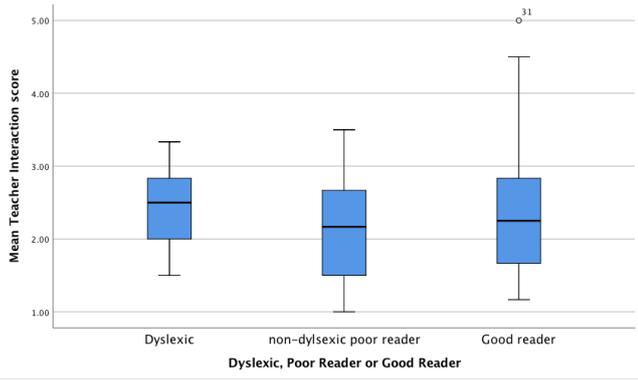
Figure Y-1. Box plots for Teacher Interaction stress across group.
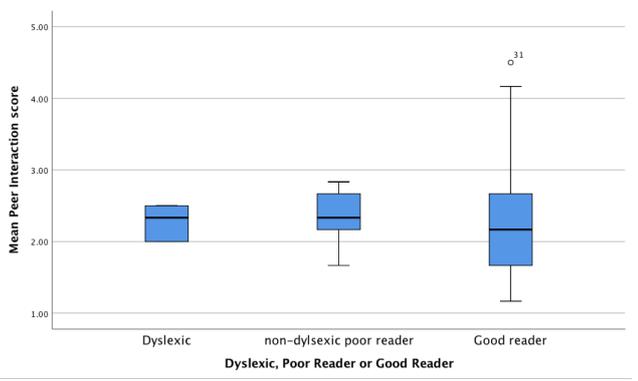
Figure Y-2. Box plots for Peer Interaction stress across groups.
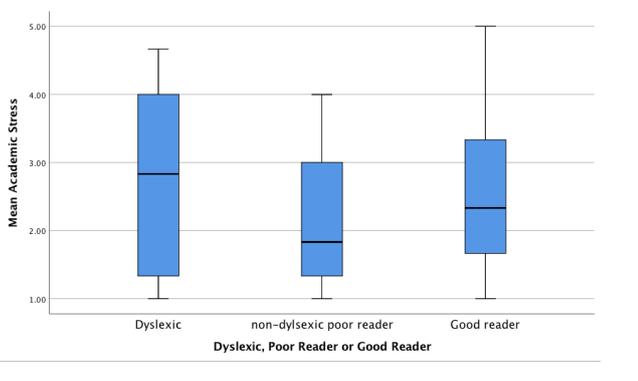
Figure Y-3. Box plots for Academic Stress across groups.
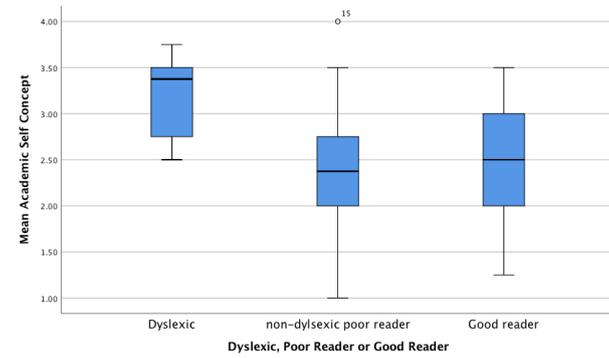
Figure Y-4. Box plots for Academic self-concept stress across group.

Further testing was carried out for multivariate outliers by calculating Mahalanobis distances. Analysis with participant ID as the dependent variable and the source of stress dimensions as the independent variables, revealed maximum Mahalanobis distance of 15.07 which is well within the critical value of Mahalanobis distance (18.47) for a model with four independent variables, as recommended by Pearson and Hartley (1966). Therefore the participant was not removed from the study and the assumption of no multivariate outliers was not considered to be violated.

5. There should be multivariate normality

Normality of each of the dependent variables (the stress source subscales scores) is used to show that this assumption has been met. Therefore, normality of each dependent variable for each of the groups was carried out to test for best-estimate of multivariate normality (see Table Y-1), by calculating standardised skewness and kurtosis, running Kolmogorov-Smirnov and Shapiro-Wilk normality tests. The assumption of univariate normality for the four stress sources was not particularly violated. While standardised skewness was not within the (-2, +2) range for *teacher interaction* and *peer interactions* for the group with no significant reading difficulties, the Shapiro Wilk normality test revealed significant deviations from normality($p < .05$) for only *teacher interaction* and *peer interactions*(for the readers with no significant reading difficulties) and *academic stress* (for the generic poor readers)(Table Y-1). There were no obvious violations from normality from observations of histogram distributions (Appendix U).

Table Y-1. *Normality measures of stress source dimensions for each reading group and normality test significance.*

Stress Source Dimension	Reading Group	Normality measure	Statistic	Std error	Standardised	Shapiro-Wilk *p*-value
Peer Interactions	D-TP	*Skewness*	-.523	.845	-.619	.093
		Kurtosis	-1.875	1.741	-1.077	
	Generic poor readers	*Skewness*	-.323	.597	-.541	.232
		Kurtosis	-1.875	1.154	-1.625	
	No sig. reading difficulties	*Skewness*	1.318	.403	2.481	.004
		Kurtosis	1.945	.788	2.468	
Teacher Interactions	D-TP	*Skewness*	-.177	.845	-.201	.996
		Kurtosis	-.318	1.741	-.183	
	Generic poor readers	*Skewness*	-.097	.597	-.165	.418
		Kurtosis	-.950	1.154	-.823	
	No sig. reading difficulties	*Skewness*	1.132	.403	2.809	.008
		Kurtosis	1.111	.788	1.409	
Academic	D-TP	*Skewness*	.014	.845	.0166	.400
		Kurtosis	-2.380	1.741	1.367	
	Generic poor readers	*Skewness*	.548	.597	1.675	.038
		Kurtosis	-1.192	1.154	-1.033	
	No sig. reading difficulties	*Skewness*	.374	.403	.928	.097
		Kurtosis	-.699	.788	-.887	
Academic Self-Concept	Dyslexic-type profile	*Skewness*	-.638	.845	-.755	.452
		Kurtosis	-1.243	1.741	-.714	
	Generic poor readers	*Skewness*	-.060	.597	-.101	.757
		Kurtosis	-.207	1.154	-.179	
	No sig. reading difficulties	*Skewness*	-.211	.403	-.524	.093
		Kurtosis	-.755	.788	-.958	

N=54
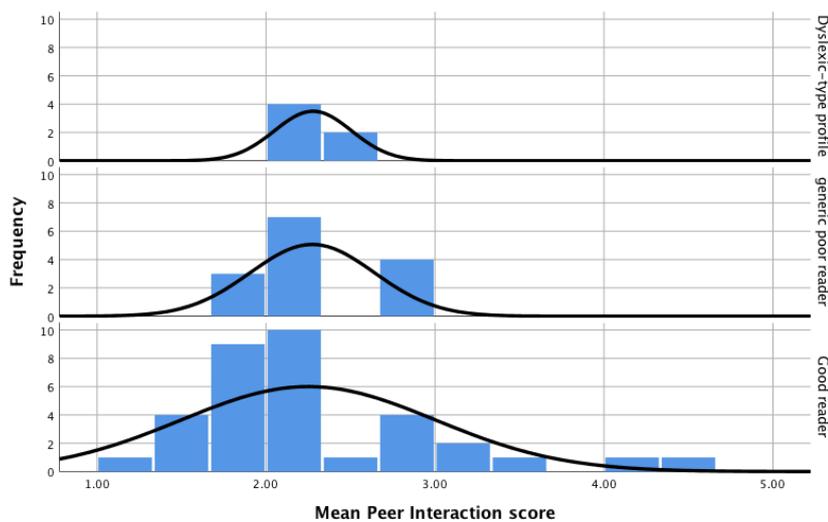
Figure Y-5. Distribution of peer interaction stress reported across groups
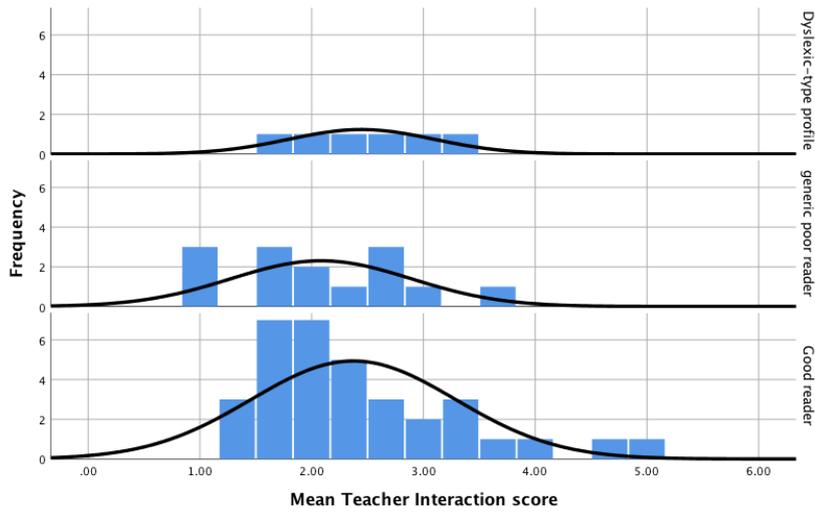
Figure Y-6. Distribution of teacher interaction stress reported across groups
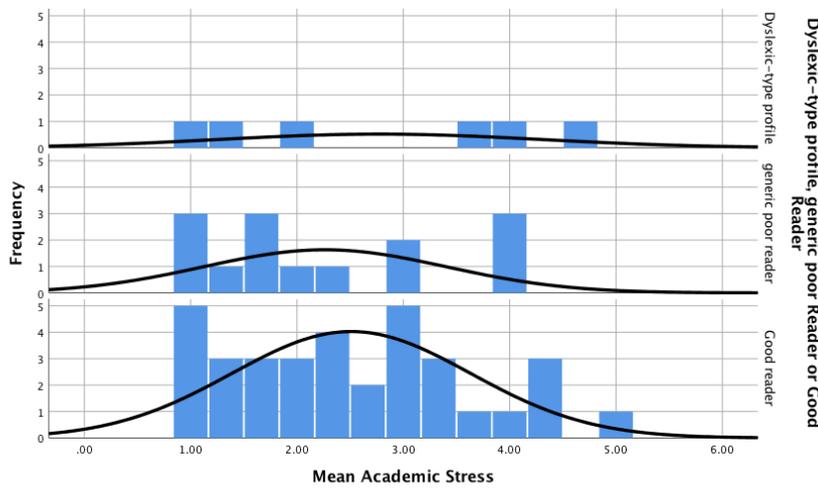
Figure Y-7. Distribution of Academic stress reported across groups
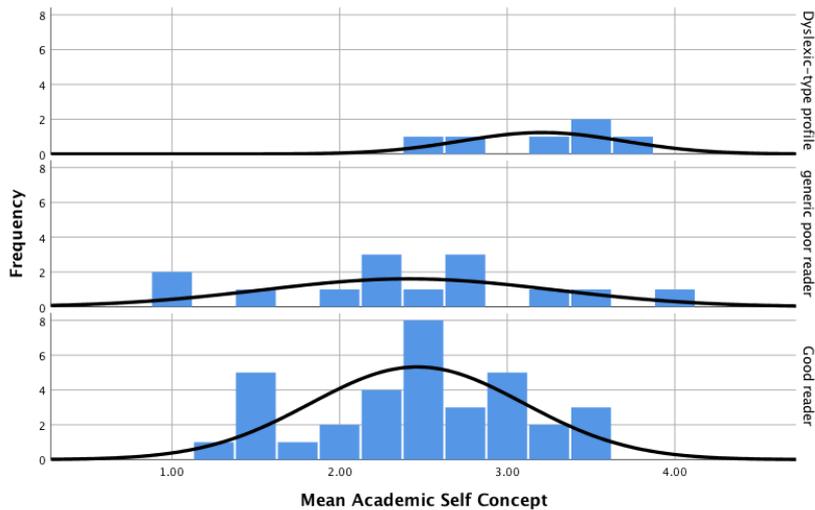
Figure Y-8. Distribution of Academic self-concept stress reported across groups

6. There should be no multicollinearity.

A series of Pearson correlations were performed between the four sources of stress variables in order to test the assumption of multicollinearity/singularity (i.e., the MANOVA assumption that the dependent variables would be correlated with each other in the moderate range). As the variables were correlated in the moderate range and there was no very high intercorrelations (>.90) among *teacher interactions*, *peer interaction, academic stress* and *self-concept* (see Chapter 4, Table 7), the assumption of multicollinearity/singularity was met.

7. There should be a linear relationship between the dependent variables for each group of the independent variable.

The assumption of linear relationships among dependent stress source variables in a multivariate model was met, for each pair of the variables according to the scatter diagrams (Figures Y9 – Y13).
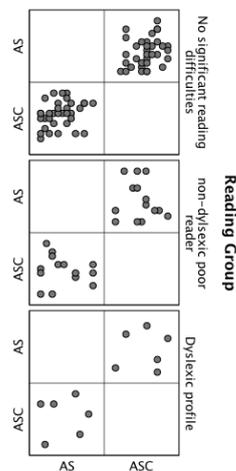
Figure Y-9. Scatter diagram of the relationship between academic self-concept and academic stress across groups
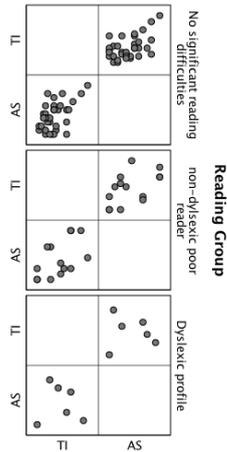
FigureY-10. Scatter diagram of the relationship between academic stress and teacher interactions across groups.
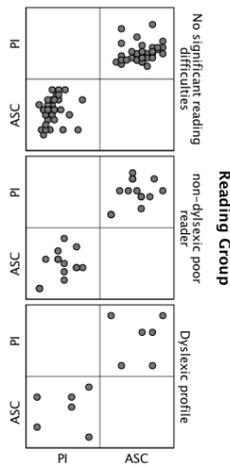
Figure Y-11. Scatter diagram of the relationship between academic self-concept and peer interactions across groups.
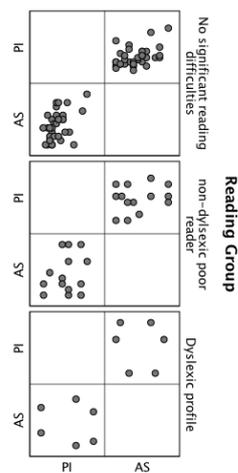
Figure Y-12. Scatter diagram of the relationship between academic stress and peer interactions across groups.
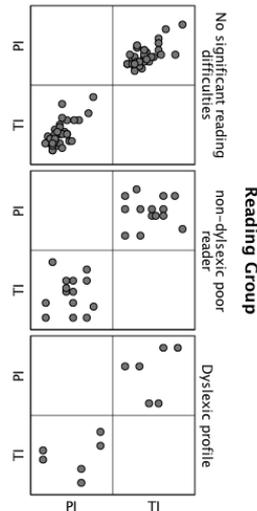
Figure Y-13. Scatter diagram of the relationship between peer interactions and teacher interaction across groups.

8. There should be an adequate sample size.

The sample size was tested, as more participants are required per cell than the number of dependent variables, for the sample size to be considered adequate. The assumption of sample size was met, as there were more participants in each group than dependent variables.

9. There should be homogeneity of variances-covariance matrices and homogeneity of variances.

The assumption of equality of covariance matrices was met, according to Box's M value of 36.719 ($p = .108$). Further check of the diagonals of the covariance matrices confirmed this. Levene's test of equality of error variances was run. The significance values for the sources of stress dimensions were greater than 0.10 for all dimensions, with the exception of *Peer Interaction* stress, which resulted in a significance value of 0.037. Overall, for the purposes of the MANOVA, the assumption was met that the covariance matrices between the groups was equal and there was homogeneity of variances.

T-test assumption checking

The assumptions that must be satisfied for a t-test analysis were identified from Laerd Statistics (2015), as outlined below. Some of the required assumption checking has

already been carried out in relation to the multivariate assumptions and will be stated as such. Otherwise, assumption checking was carried out as follows:

1. **The collected data should follow a continuous or ordinal scale.**

Assumption is met (as outlined in assumption (1) of the multivariate assumption testing).

2. **One independent variable that consists of two independent groups**.

This assumption is met, as the reading groups (i.e., the independent variables) that are being compared, are independent groups.

3. **Independence of observations.**

This assumption requires there to be no relationship between the groups. This assumption was met by each group having different participants.

4. **There should be no significant outliers within each group.**

In terms of the dependent variables, there should be no especially high or low scores within each group. This was already assessed for the multivariate analysis assumptions, via boxplots for each groups' scores on each of the six anxiety dimensions (see assumption (4) testing for the multivariate analysis). As before, the few outliers were not excluded from the study, as they had scores between $0 - 3$, in the range of all anxiety subscale scores.

5. **The dependent variable should be approximately normally distributed.**

Shapiro-Wilk normality statistics were already run for the multivariate analysis assumption checking and while there were some deviations from normality (see Table Y-1) ,there were no obvious violations from normality from observations of histogram distributions (Figures Y5-Y8). Despite the Shapiro-Wilk's test results (Table Y1) not demonstrating normality for *teacher interaction*s, *peer interactions* and *academic stress separation* and *obsessive-compulsive* anxiety, it was decided to run the test anyhow, as the independent-samples t-test is reasonably robust to normality deviations.

6. **The assumption of homogeneity of variance**.

This assumption states that the variance must be equal in each group of the independent variables. Equal variance exists when the standard deviations of samples are approximately equal. The assumption of homogeneity of variances was met, as assessed by Levene's test for equality of variances, with significance values being greater than 0.10 for all source of stress dimensions, with the exception of *Peer Interaction* stress, which resulted in a significance value of 0.037. Overall this assumption was not violated, allowing for t-test analysis to be carried out.

Appendix Z. Assumption testing before statistical analysis of stress manifestation group differences.

The assumptions that must be satisfied for a MANOVA analysis were identified from Laerd Statistics (2015), and assumption checking was carried out as follows:

Testing the assumptions of multivariate analysis of variance

The assumption of sample size was met, as there were more participants in each group than dependent variables (Chapter 4, Table 20) The assumption of univariate normality was not violated, as standardised skewness and kurtosis values at group level were well within the (-2, +2) range for all stress manifestation dimensions (Table Z-1). Histogram distributions did not reveal deviations from normality (Figures Z1 – Z3), and according to boxplots (Figures Z4 – Z6), there were no outliers within groups across the three subscales.

Table Z-1.

Normality measures of stress manifestation dimensions for each reading group and normality test significance.

| Stress Manifestation	Reading Group	Normality measure	Statistic	Standard error	Standardised	Shapiro-Wilk *p*-value
Emotional	Dyslexia-type profile	*Skewness*	.619	.845	.732	.542
		Kurtosis	-.981	1.741	-.563	
	Poor reader	*Skewness*	.504	.597	.844	.385
		Kurtosis	-.467	1.154	-.405	
	No sig. reading difficulties	*Skewness*	-.201	.403	-.499	.155
		Kurtosis	-.316	.788	-.788	
Behavioural	Dyslexia profile	*Skewness*	-.700	.845	-.828	.726
		Kurtosis	.817	1.741	.469	
	Poor reader	*Skewness*	.275	.597	.461	.271
		Kurtosis	-1.046	1.154	-.907	
	No sig. reading difficulties	*Skewness*	.383	.403	.950	.068
		Kurtosis	-.222	.788	-.282	
Physiological	Dyslexia Profile	*Skewness*	.053	.845	.063	.493
		Kurtosis	-1.721	1.741	-.989	
	Poor reader	*Skewness*	.491	.597	.823	.065
		Kurtosis	-.667	1.154	-.581	
	No sig. reading difficulties	*Skewness*	-.031	.403	-.077	.376
		Kurtosis	-.406	.788	-.515	
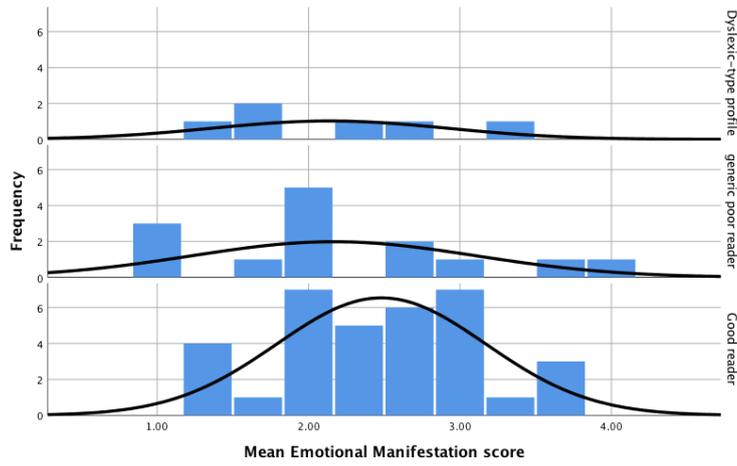
*Figure Z-1.* Distribution of emotional manifestations of stress reported across groups.
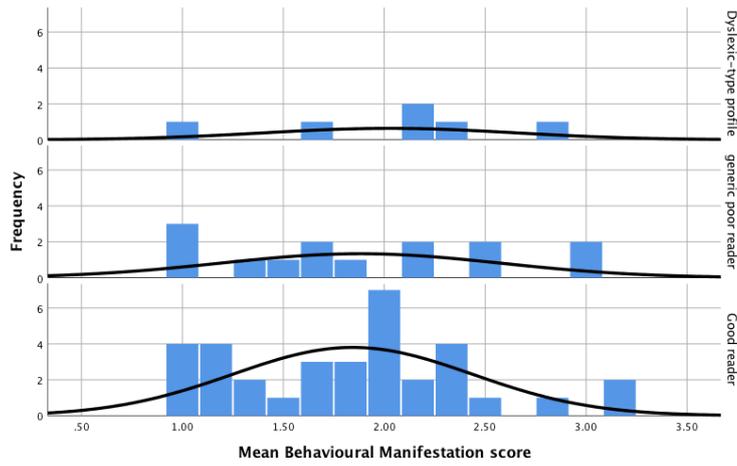
*Figure Z-2.* Distribution of behavioural manifestations of stress reported across groups.
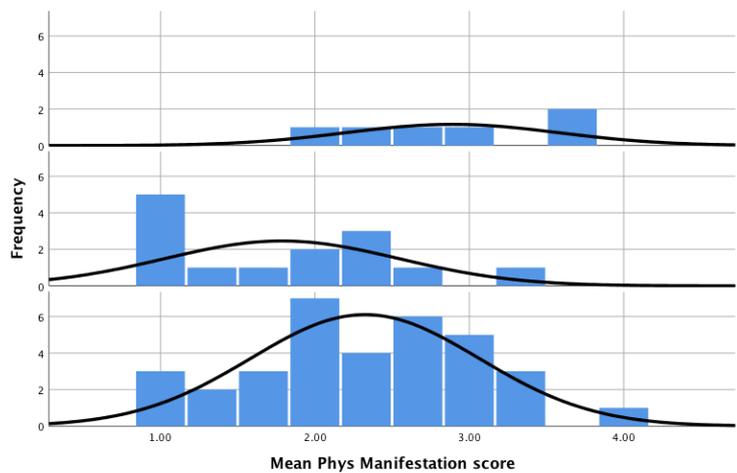
*Figure Z-3*. Distribution of physiological manifestations of stress reported across groups.
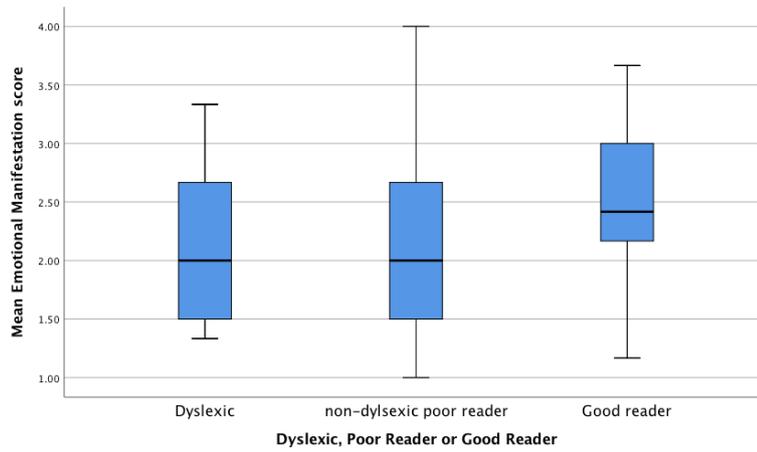
*Figure Z-4*. Box plots for Emotional Manifestations of Stress across groups.
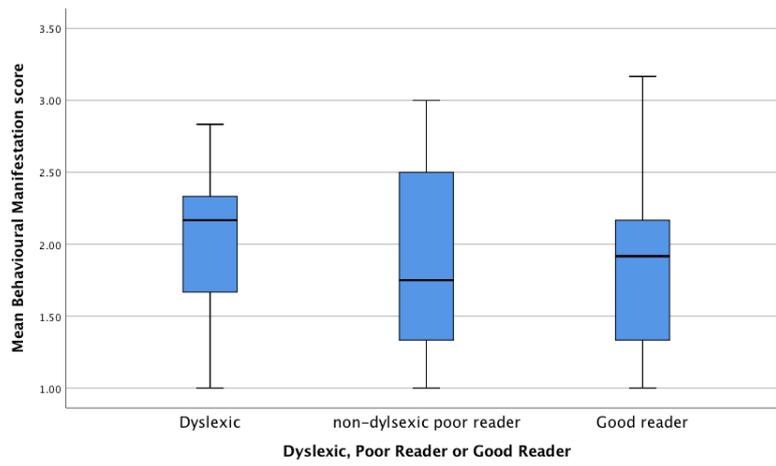
*Figure Z-5*. Box plots for Behavioural Manifestations of Stress across groups.
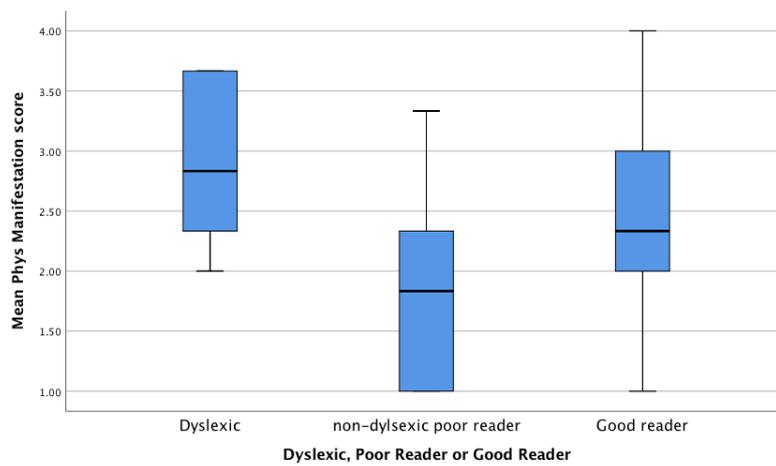
Figure Z-6. Box plots for Physiological Manifestations of Stress across groups.

Multivariate normality analysis revealed maximum Mahalanobis distance of 12.99, which is well below the critical distance of 16.27 recommended by Pearson and Hartley (1966), for a model with three independent variables. Additionally, Cook's distance was revealed to be .118, which was close to the recommended value of 1.00 (Tabachnick & Fidell, 2007). Therefore the assumption of multivariate normality was not considered to be importantly violated. The assumption of linear relationships among the variables for a multivariate model was also met, as shown in the paired variable scatterplots (Figure Z7 – Z9). Additionally, as the variables were correlated in the moderate range (.52 - .70, Chapter 4, Table 7) and there were no very high intercorrelations (i.e., >.90) among the three manifestations of stress subscales, the assumption of multicollinearity/singularity was not violated.
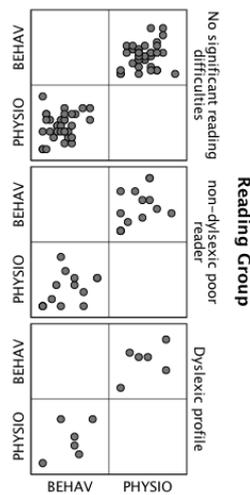

Figure Z-7. Scatter diagram of the relationship between physiological stress and behavioural manifestations across groups.
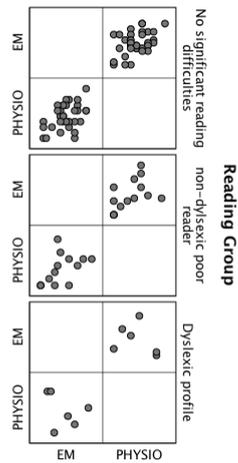
Figure Z-8. Scatter diagram of the relationship between Physiological manifestations and Emotional Manifestations across groups.
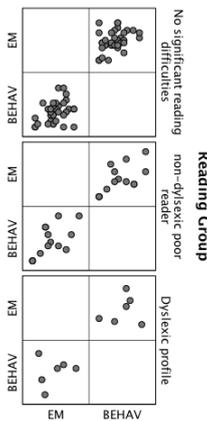

Figure Z-9. Scatter diagram of the relationship between Behavioural manifestations emotional manifestations across groups.

The pattern of significant moderated correlations observed amongst the three manifestation of stress variables, suggested a MANOVA to be appropriate. The assumption of equality of covariance matrices was met, according to the Box's test (p = .885). Additionally, Levene's test indicated equal variances (p> 0.10) across all dimensions. Therefore, the assumption of equality of covariance matrices was met and MANOVA deemed appropriate.

Appendix AA. Sample Size Calculation for cross-sectional prevalence study.

The following formula was used for calculating an adequate sample size in this prevalence study and drawn from Daniel and Cross (2018):

$$n = \frac{Z^2\ P\ (1\text{-}P)}{d^2}$$

Where n is the sample size; Z corresponds to 95%, as the chosen level of confidence; P is the expected prevalence (10%), obtained from similar studies and d is precision (.02) corresponding to effect size. The choice of .02 for precision was draw from recommendations by Pourhoseingholi, Vahedi & Rahimzadeh (2013), to utilise a figure of one fifth of the estimated prevalence.

The results of this calculation can be seen below:

$$n = \frac{.95^2\ \text{X}\ 0.1(1\text{-}0.1)}{0.02^2} = \textbf{203}$$