The Dyslexia System: Using the Millennium Cohort Study and a survey of teachers to investigate the perceptions, predictors and repercussions of the dyslexia label.

Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

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Abstract

In the current academic climate, the concept of dyslexia is being increasingly questioned. This thesis aims to contribute to this debate by focusing on the dyslexia label, how it is acquired and the real impact it can have on both the individual and those around them. It examines the various factors that may be involved in influencing a dyslexic individual by looking, not only at the individual, but also at the environment in which they are situated. Thus, the term 'dyslexic system' is defined to describe how the individual and their environment interact.

The research involved the use of two datasets. Firstly, the Millennium Cohort Study was used to examine what socio-demographic and individual level factors influenced whether the cohort member had a diagnosis of dyslexia at ages 7, 11 and 14 in England and in Wales. Using this information, the impact of the dyslexia label on academic self-concept was then investigated. Secondly, primary survey data from teachers in England and Wales was used to investigate how teachers understood dyslexia.

Logistic regression analysis of the Millennium Cohort Study showed that both individual and social demographic factors impacted whether a cohort member had been labelled with dyslexia. Sex, social class, parents' education, income, having an older sibling and age in year group were all significant predictors of dyslexia at varying ages. Furthermore, when dyslexic and non-dyslexic cohort members were matched on these characteristics using propensity score matching, those labelled with dyslexia had a lower academic self-concept than those without this label. Teachers and parents also held lower aspirations for children labelled with dyslexia, despite the groups being matched on ability.

Results from the teacher survey showed that the majority of teachers surveyed did not show an understanding of the biological and cognitive aspects of dyslexia which have been found to be important for effective intervention. Furthermore, teachers reported poor teacher training on dyslexia.

Factors seemingly unrelated to dyslexia influence whether a child is labelled as dyslexic in England and Wales. This suggests that that the label is not evenly distributed across the population and indicates that resources for support may not be being fairly allocated. Furthermore, the dyslexia label also negatively impacts the child's academic outlook and evokes a stereotypical understanding in teachers. These findings highlight the importance of looking at dyslexia as a system. The results foreground the need for change in the current system.

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List of abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
ALN	Additional Learning Needs
BDA	British Dyslexia Association
CFA	Confirmatory Factor Analysis
CPD	Continued Professional Development
DSM	Diagnostic and Statistical Manual of Mental Disorders
GTP	Graduate Training Programme
ICD	International Classification of Diseases and Related Health Problems
ITE	Initial Teacher Education
JCQ	Joint Council for Qualifications
LEA	Local Education Authority
M	Mean
MCS	Millennium Cohort Study
MRI	Magnetic Resonance Imaging
N	Number of Participants
NHS	National Health Service
NPD	National Pupil Database
NS-SeC	National Statistics Socio-economic Classification
NQT	Newly Qualified Teacher
NVQ	National Vocational Qualification
OECD	Organisation for Economic Co-operation and Development
p	Significance Level
PE	Physical Education
PGCE	Postgraduate Certificate in Education
PSM	Propensity Score Matching
QTS	Qualified Teacher Status
RAN	Rapid Atomised Naming
SCITT	School Centred Initial Teacher Training
SD	Standard Deviation
SEN	Special Educational Needs
SEND	Special Educational Need and Disability

SENCo   Special Education Needs Coordinator

SpLD   Specific Learning Difficulty

UK   United Kingdom

USA   United States of America

z   Adjusted Standardised Residual

CHAPTER 1

Introduction

1| Introduction

In 2000 Pamela Phelps successfully sued her former education authority for failing to diagnose her with dyslexia. In her putting her case forward she argued that if her dyslexia have been diagnosed during her education her difficulties would have been more likely to be overcome (House of Lords, 2000). As Pamela Phelps had received additional support while she was at school, her argument was not based around whether or not she should have received support, but that failure to diagnose and consequently acquire a label of dyslexia would have had a positive impact on her outcomes. This thesis seeks to explore the assumption that firstly dyslexia exists and it is diagnosable, and secondly, that diagnosis and subsequent labelling of dyslexia has a positive impact.

1.1 The dyslexia debate

This thesis will use 'the dyslexia debate' to frame the discussion and to question the benefits of the dyslexic label. This broadly describes the debate about how we use the term 'dyslexia' and whether individuals should receive it as a diagnosis. This was brought into the public eye in 2009 when the British politician Graham Stringer MP gained media attention on the subject when he called dyslexia a "cruel fiction" saying that "to label children with dyslexia because they are confused is wicked" (BBC News, 14/01/2009). Stringer said that children who were struggling with literacy issues were doing so due to failures in the education system, not due to the presence of a medical condition called dyslexia. This extreme opinion about dyslexia was dismissed by most, with the charity Dyslexia Action responding by saying "it is frustrating that the focus should be on whether dyslexia exists or not, when there is so much evidence to support that it does" (BBC News, 14/01/2009). Indeed, there has been an increasing amount of research into both the biological and cognitive bases of dyslexia which will be discussed in detail in Chapter 2 of this thesis. However, as will also be discussed, key aspects of this research has been debated and challenged in recent years by those suggesting that there are no clear differences between those with dyslexia and those who show difficulty

reading. This argument has been a key theme of the work of Elliot et al. for many years (Elliott & Gibbs, 2008; Elliott & Grigorenko, 2014; Elliott, Jenkins, Snowling, & Thompson, 2005).

In 2014, when I began this PhD, Elliot and Grigorenko published the book 'The Dyslexia Debate' which systematically questions the evidence that dyslexia exists and asks whether there is any benefit of being diagnosed with dyslexia (Elliot & Grigorenko, 2014). This book gained attention in the UK media who picked up, in particular, on the claims that dyslexia is a middle class phenomenon (Daily Mail, 26/02/2014; Independent, 27/02/2014). This debate created a 'perfect storm' in providing inspiration for the research upon which this thesis is based. While Elliot and Grigorenko (2014) challenge the dyslexia label by contesting the existing biological and cognitive evidence on dyslexia, this thesis intends to extend this debate further by questioning what else, other than biology and cognition, may be involved in defining dyslexia and the impact that this may have on dyslexic individuals.

1.1.1 Personal experience

Whilst having an academic interest in this area of study, the subject matter also has personal relevance to me. My own dyslexia was identified and diagnosed when I was 17. Since then I have questioned the 'dyslexia debate' by wondering how my academic life may have been different should my dyslexia have been identified at a younger age.

While this thesis is not auto-ethnographer, nor written drawing upon my personal experience or my 'insider' knowledge of dyslexia, it seemed important to mention my own dyslexia in this introduction and how this has framed my research interests.

1.2 Description of the thesis

1.2.1 Gap in current research

The literature review will continually refer to gaps in current research. However, more broadly, the thesis covers two areas that I believe have not been given sufficient coverage in dyslexia research. Firstly, research has

tended to focus on individual specific aspects of dyslexia. While significant research has explored the relationship between dyslexia and self-concept, it does not look at the wider picture of dyslexia and consider it within its social and cultural context. In order to get a full understanding of dyslexia it is important to situate and attempt to understand it within its wider context. Secondly, the thesis looks at the dyslexia debate from a social perspective. This is important as although there are arguments against diagnosis using biological and cognitive evidence, if it is found that the label benefits an individual's self-concept, then it could be argued that we should continue to diagnose with dyslexia.

1.2.2 The dyslexia system

This thesis examines what I refer to as the 'dyslexia system': viewing dyslexia as a complex holistic system. Research on dyslexia has tended to view dyslexia as it impacts specific 'dyslexic individuals'. While this has given us important knowledge about what dyslexia potentially is, it fails to take into account the wider context from which dyslexia may emerge. In his research on autism, Bearman (2013) points out that while research on genetics is important, it is also important to establish "which kinds of social and cultural factors matter, why they matter and when they matter" (p.11). A similar perspective that will be taken in this thesis.

In order to develop the concept of the dyslexia system, the thesis combines ideas from three differing theoretical and conceptual frameworks: Frith's causal model (Frith, 1995; 1999), Bronfenbrenner's ecological systems model (Bronfenbrenner, 1979); and, complexity theory (integration of these models is discussed in detail in Section 3.2). Combining these models provides a new and innovative framework from which to investigate dyslexia.

1.2.3 The approach taken

As the research aimed to explore patterns in the dyslexic system, large-scale data were needed to look for these trends. The key statistical methods that have been employed in this thesis are *bivariate analysis* to look for significant relationships in the data; *logistic regression* to disentangle the

relationships between significant variables and to look for patterns in the data; and, *propensity score matching* to isolate the impact of the dyslexia label. Further details and justification for these methods will be provided in the chapters 4, 5 and 8.

1.3 Thesis outline

The thesis is structured as follows: Chapters 2 and 3 explore the relevant literature on the area. *Chapter 2: Understanding Dyslexia,* begins by discussing how we currently define dyslexia. In order to situate the current understandings of dyslexia, the history of dyslexia is firstly discussed. This is followed by a critical discussion of the modern theories of dyslexia, split into biological, cognitive and behavioural perspectives. Chapter 2 concludes by suggesting that there is not a clear picture of what dyslexia is, therefore, it needs to be questioned whether we can claim that one thing such as 'dyslexia' exists. *Chapter 3: The social reality of dyslexia* then moves on to consider how the environment may interact with the biological, cognitive and behavioural aspects of dyslexia. This firstly examines Bronfenbrenner's Ecological Systems model and provides justification for why it is also important to examine the individuals' environment in this research. Complexity theory is then applied to account for issues in Bronfenbrenner's model, before the concept of the dyslexic system is proposed. This is followed by examination of the different levels of the system and how they may impact the individual. This is done by firstly looking at how teachers may impact those with dyslexia, followed by exploration of current policy around dyslexia. Finally, it looks at the potential impact of wider aspects such as social class. Chapter 3 is concluded with the research questions that aimed to be answered in this thesis.

 Chapter 3: Methodology discusses the epistemological and ontological foundation of the methods. In this research a two-study approach is taken. The Millennium Cohort Study (MCS) is presented first. *Chapter 5*: *MCS Methods* discusses in detail the methods used in analysing these data. This is followed by the results being presented in *Chapter 6: MCS Results*, and a discussion of the results in *Chapter 7: MCS Discussion*. The same format is then followed for the teacher survey. Methods are

presented in *Chapter 8: Teacher Survey Methods* followed by the results in *Chapter 9: Teacher Survey Results.* Finally, there is a discussion about these results in *Chapter 10: Teacher Survey Discussion.*

The final chapter, *Chapter 11: Concluding Discussion* then pulls together the previous discussion chapters and looks at what the results tell us about the dyslexia system as a whole. Implications for policy and practice are presented, followed by a discussion of the strengths and limitations of the thesis and directions for future research. A conclusion is then drawn in response to both the research questions posed, and the wider contributions of this thesis.

CHAPTER 2

Understanding Dyslexia

2 | Understanding Dyslexia

2.1 Formal definitions of dyslexia

It is first necessary to get an initial understanding of what dyslexia is. Baskar (2008) stated that "things exist and act independently of our descriptions but we can only know them under particular descriptions" (p.250). Therefore, while there may be physical and social contributors that make up dyslexia, without naming it and defining it, we cannot examine and research it. Therefore, the following section questions how dyslexia is formally defined, in order to establish how this may impact our understanding of it.

There are two types of dyslexia: acquired and developmental. Acquired dyslexia is caused by some damage to the brain, for example, damage due to a stroke or injury. This injury causes disruption to an already established skill which is associated with dyslexia. For example, losing the ability to decode text. Developmental dyslexia, on the other hand, is considered as being due to some inherent differences that the person is born with. This thesis is concerned with developmental dyslexia.

It is initially important to examine how official organisations define dyslexia in order to frame the discussion of dyslexia in this thesis. The UK's Department of Education first gave dyslexia recognition in its 'Code of Practice' in 1994, in which they used the terminology 'specific learning difficulties e.g. dyslexia' (Department of Education, 1994). Prior to this the phrase 'specific learning difficulty' (SpLD) figured more prominently in literature and policy (Lawrence, 2009). Within the current education system there is an awareness of dyslexia and diagnosis is becoming more common. However, in recent years there has been controversy over the nature of dyslexia. The Dyslexia Action Report (2012) suggests that "there is no longer controversy about whether is exists and how to define it" (Dyslexia Action, 2012, p7). However, other researchers disagree; Elliot and Grigorenko (2014) claim that "the field has been unable to produce a universally accepted definition [of dyslexia] that is not imprecise, amorphous or difficult to operationalise" (Elliott & Grigorenko, 2014, p5).

In 2009 the 'No to Failure Report' recommended that there needed to be a large-scale change in how children with dyslexia are taught in the United Kingdom (UK) (Dyslexia-SpLD-Trust, 2009). Consequently, the government commissioned Sir Jim Rose (formerly Her Majesty's Chief Inspector (HMI) of Primary Education, and Director of Inspection for the Office for Standards in Education (Ofsted) in England) to conduct a review into the current provisions for dyslexia and to make recommendations for change. As part of this review, Rose (2009) provided a definition of dyslexia with aims to make this the national definition. As a result, UK based charities (British Dyslexia Association; Dyslexia Action) and the National Health Service (NHS) now use this as their working definition of dyslexia. The full definition suggested by Rose is:

> Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling.
>
> • Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed.
>
> • Dyslexia occurs across the range of intellectual abilities.
>
> • It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points.
>
> • Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia.
>
> A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well-founded intervention (Rose, 2009, p.31).

The Rose definition describes dyslexia directly (as opposed to specific learning difficulties) and discusses both the behavioural and cognitive aspects associated with dyslexia, as well as saying that it may co-occur with other difficulties.

On the other hand, more global organisations do not refer to dyslexia directly and refer to it under the banner of 'specific learning disorder'. The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the handbook used by health care professionals in the United States of America (USA) and states that it serves as a universal authority for psychiatric diagnoses; the fifth and most recent version of the DSM was published in

2013. In this, dyslexia is included under the broader title of 'specific learning disorder' (see Appendix A for full definition). The DSM suggests that to fall within this category the person must show at least one of a list of symptoms broadly related to academic skills. This definition is followed with a subheading titled 'with impairment in reading' in which dyslexia is directly refer to as: "an alternative term used to refer to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding, and poor spelling abilities" (American Psychiatric Association, 2013, p.67). Dyslexia is therefore regarded as an alternative way of referring to this specific learning disorder, relating more specifically to reading impairments. Furthermore, the 'International Classification of Diseases and Related Health Problems', which is now in its tenth version (ICD-10), is a similar handbook used for the purpose of diagnosis. The ICD is published and maintained by the World Health Organisation (WHO). Within the ICD-10, dyslexia is mentioned within the category of 'specific reading disorder', which is within the broader category of 'specific developmental disorders of scholastic skills' (WHO, 1993) (see Appendix A for full definition).

Finally, in addition to definitions provided by government organisations and public bodies a definition of dyslexia has also been suggested by those within academia. Lyon, Shaywitz and Shaywitz (2003) who are well known researchers in the field of dyslexia suggest a working definition of dyslexia. This definition refers directly to dyslexia stating that "dyslexia is a specific learning disability that is neuro-biological in origin" (p. 2). This definition differs to the others discussed as it not only refers directly to the neuro-biology research around dyslexia but also aligns dyslexia with a SpLD (see Appendix A for full definition).

The definitions provided by these organisations are mainly descriptive and causation is not referred to in the practitioner used definitions of dyslexia. All four definitions recognise difficulties with reading as being a component of dyslexia or specific learning difficulty. Correspondingly, a research report, commissioned by the Welsh Government, analysed 11 definitions of dyslexia produced by various organisations between 2002 and 2009. They found that "literacy difficulty

[was] the only universally recognised component of dyslexia [in all definitions]" (Caravolas, Kirby, Fawcett, & Glendenning, 2012, p.47).

The academic definition provided by Lyon, Shaywitz and Shaywitz (2003) refers to dyslexia as being neurological in origin. It is easy to see why an academic definition of dyslexia may include the neurological aspects, whilst the definitions that are used to form the basis of diagnostic criteria do not. In practice it would be very hard to identify those that are dyslexic according to whether or not they show a particular neurological abnormality, therefore, to include this in a working definition may cause problems for the practitioner. However, researchers can explore the possibilities of dyslexia at the biological level.

Given the variety of ways that dyslexia is referred to by the different organisations it is of importance to specify that this thesis will focus on 'dyslexia' rather than 'specific learning difficulties'.

2.2 History

Alongside examining the current definitions of dyslexia, it is also important to understand the historical underpinnings of the term in an attempt to help understand how dyslexia is understood today.

2.2.1 Pre-1990

In 1870 the Forster Education Act guaranteed a basic level of education to all children in the UK. This meant that educators could now view and compare large numbers of children, and therefore, could identify those who were showing particular learning difficulties. Those showing such difficulties were classed as 'educationally subnormal' or 'severely subnormal' (Middleton, 2010). At this time learning difficulties were considered medical issues and doctors were involved in identifying the symptoms that may now be recognised as dyslexia. As a result, medical accounts were turned to in an attempt to understand the symptoms that a minority of individuals were showing.

The first cases of loss of reading ability were reported in patients who had suffered a form of brain injury and had 'acquired dyslexia'. The first reported case was published by Schmidt, a physician in 1676 who

described a patient who had lost the ability to read due to what would now be recognised as a stroke. As the concept evolved, cases appeared in the literature describing people who had once been able readers but due to injury had lost the ability to read. In 1877 Kussmaul coined the term 'word-blindness' to describe the phenomena which he described as "complete text-blindness […] although the power of sight, the intellect and the powers of speech are intact" (Kussmaul, 1877, cited in Shaywitz, 2003, p.16). The first to use the word 'dyslexia' was Berlin in 1887 however, the term world-blindness was more commonly used to describe the inability to read. A key milestone in the history of dyslexia was an article that was published in *The Lancet* in 1891 by Dejerine. In this article, Dejerine concluded that dyslexia was the result of brain injury and therefore, language difficulties were related to brain dysfunction. This model of understanding was then applied to those who had reading difficulties. Thus, children who had reading difficulties were considered to have a neurological impairment.

In 1895 a further article was published in *The Lancet* by eye surgeon Hinshelwood. He wrote about a patient who had reading difficulties, along with genetic deficits with his eyesight. Hinshelwood suggested that reading difficulties were a malfunction of eyesight and that this was due to a neurological deficit. In response to this article Morgan wrote in the British Medical Journal in 1896 about a fourteen-year-old boy:

> The greatest efforts have been made to teach him to read, but, in spite of this laborious and persistent training, he can only with difficulty spell out words of one syllable […]He says he is fond of arithmetic, and finds no difficulty with it, but that printed or written words "have little to no meaning to him," and my examination of him quite convinces me that he is correct in that opinion[…] I might add that the boy is bright and of average intelligence in conversation. His eyes are normal, and his eyesight is good. The schoolmaster who has taught him for some years says that he would be the smartest lad in the school if the instruction were entirely oral. (Morgan, 1896, cited in, Shaywitz, 2003, p.13).

The definition of the boy fits what we would now associate with dyslexia. The boy described here poses an anomaly to Morgan who felt that it was of importance to record and share his account of this boy. Morgan, following on from Hinshelwood, titled this article 'congenital word blindness'.

2.2.2 1900-1950

Hinshelwood continued work on congenital word blindness, publishing a series of articles describing similar cases. He defined it as "a congenital defect occurring in children with otherwise normal and undamaged brains characterised by a difficulty in learning to read" (Hinshelwood, 1917, p.40) Hinshelwood believed that dyslexia was a local cerebral dysfunction, rather than a general one. Therefore, he suggested that someone who is showing deficits in all cognitive skills is not dyslexic as he believed that a dyslexic person will show some cognitive strengths.

Orton (1925) introduced the word 'stephosymolia' (meaning twisted signs) to describe people who had difficulty reading. Orton was a neurologist who worked primarily with stroke patients and was interested to find a girl who showed the same symptoms as stroke patients, but who had not suffered any brain injury. Orton continued work in the area and suggested that these symptoms were the result of failure to establish hemispheric dominance in the brain. This differed from previous explanations which suggested that visual deficits were the cause of the symptoms.

It was not until mid-1930s that the term dyslexia began to be used more widely. The word dyslexia is Greek in origin. It combines the words 'dys' meaning absence, with 'lexia' meaning language, therefore literally translating as an absence of language. Hinshelwood believed that those that have dyslexia are individuals who show small delays in learning to read, whereas those who suffer with word blindness have severe cases of pure reading disability.

Between the 1930s and the 1950s there began to be a shift between viewing dyslexia as a medical problem, to viewing it as an educational problem. As a result, interventions began to be developed looking for effective teaching methods to help children with dyslexia. Despite this, the medical profession was still responsible for the identification of those with learning difficulties.

2.2.3 Post 1950s: a shift from the medical to educational models

Until the middle of the 20th century, medical professionals were responsible for identifying individuals with learning difficulties and placing them the into appropriate 'special schools' (Lawrence, 2009). It was not until the middle of the 20th century that there was shift in understanding of learning difficulties from a medical perspective to an educational perspective. This came about, in part, due to the emergence of educational psychology as a key branch of psychology more generally. Due to this shift in understanding, learning difficulties in childhood became more commonly recognised as an educational issue. The primary responsibility for managing the issue shifted to educational establishments and away from medical ones. A key shift came in the 1970s when psychologists became responsible for the "administrative categorisation of children with learning difficulties" (Lawrence, 2009, p13). Prior to this, school medical officers were responsible for conducting the assessment of any children that showed learning difficulties. The 1978 Report in the UK advised the change in the role of the school medical officers (Warnock, 1978).

The rise in psychology also led to a shift in people's understanding of learning difficulties. Prior to the 20th century people with learning difficulties were often thought of as 'unteachable' (Lawrence, 2009). However, due to the growing presence of psychological research and knowledge, an understanding of how children learn started to emerge. From this there began to be recognition that children with learning difficulties, who may have previously been considered as unteachable, did have the ability to learn. During this time "the clinical classification of a disability of an isolated group of patients was evolving to the more realistic concept of a continuity in reading ability, with dyslexics at the lower tail of the distribution" (Guardiola, 2001, p.12). Due to this growth in knowledge of learning difficulties and how children learn, new teaching strategies were researched and implemented with the aims of helping children to reach their full potential. These were also researched in relation to learning difficulties. A prominent example of this research, in relation to learning difficulties, and in particular dyslexia, was the work of Gillingham and Stillman (1936). While the creation of this method arose before the shift to viewing dyslexia

in the educational context, the Gillingham-Stillman method was a teaching method developed specifically to help those with reading difficulties. The teaching method involved a multi-sensory approach using phonic–based visuals, auditory and kinaesthetic methods, to help children break down and read words whilst understanding their meaning (Gillingham & Stillman, 1936). The technique was very successful at the time and is still in use today.

While psychology and education were in the forefront for developing teaching strategies for children with reading difficulties, dyslexia still had its roots within the medical profession. Orton (described above as the neurologist who noted the differences between stroke patents and children with reading difficulties) collaborated with Gillingham and Stillman to publish a manual in '*Remedial Training for Children with Specific Disability in Reading, Spelling and Penmanship*' in 1946. The approach combines the teaching methods with suggestions of how cognition is involved in how we learn to read.

The advance of the use of neuroscience in order to investigate how we learn began to be paired with educational perspectives with aims to better understand dyslexia. Therefore, neuroscience became prominent in the literature around dyslexia. In 1968, Doman and Delacato proposed the theory that dyslexia and other learning difficulties are the result of deficits in the neurology of the brain (Doman, 1968). Somewhat controversially, they suggested that learning disabled children had missed out on some of the normal neurological developmental stages which all humans go through as a result of evolution. Alongside this theory Doman and Delacato proposed a treatment which they suggested would replicate the neurological stages that the child had missed. The treatment involved the individuals doing motor exercises such as crawling, balancing and stretching. These were to be done daily for up to twelve months. Like Orton, Doman and Delacato thought that dyslexia was due to abnormal hemispherical brain dominance. Therefore, Doman and Delacato believed that by doing these exercises children could achieve normal hemispherical dominance and what they described as 'full neurological organization'(Doman, Spitz, Zucman, Delacato, & Doman, 1960). Whilst a novel approach, both theory and treatment were heavily criticised (Freeman, 1967; Jacobson, Mulick, Foxx,

& Kryszak, 2015). However, whilst flawed, the theory could be seen to have made a significant contribution to how we view dyslexia today.

A key event in the history of developmental dyslexia the UK was when the 'Invalids Children's Aid Association' (ICAA) set up the 'word blind centre for dyslexic children' in 1963. The aim of the centre was to assess, teach and research dyslexic children. This was one of the first centres to specifically conduct research into the causes of dyslexia and was the stimulus for further work in the area.

2.2.4 Summary of historical dyslexia perspectives

Historically dyslexia was widely understood as a within-person difficulty with a neurobiological origin. Whilst over time there was a shift from the medical perspective to a more educational perceptive, the responsibility remained with the individual rather than the institution.

2.3 Modern theories

As previously mentioned, the Code of Practice officially gave recognition to dyslexia in 1994. Today, dyslexia is accepted as an official category of SpLD. Whilst there is still debate over the usefulness of the label, the development of advanced neurological and cognitive investigation methods have allowed more in-depth exploration into both the effects of learning difficulties and their potential causes. Snowling (2008) formed the table below presenting the characteristics that people who are reported to have dyslexia may show at different ages (Table 2.1).

Table 2.1 Dyslexia symptoms through development

Developmental Phase	Symptoms of Dyslexia
Preschool	Delayed speech Poor expressive language Poor rhyming skills Little interest/difficulty learning letters
Early school years	Poor letter-sound knowledge Poor phoneme awareness Poor word attack skills Idiosyncratic spelling Problems copying
Middle school years	Slow reading Poor decoding skills when faced with new words Phonetic spelling
Adolescence and adulthood	Poor reading fluency Slow speed of writing Poor organisation and expression in written work

(Adapted from Snowling, 2008)

Given the number of different symptoms that are listed here, it is no surprise that there is currently "no unitary explanation [of dyslexia]" (Zoccolotti & Friedmann, 2010, p.1,213) and therefore, multiple perspectives and causes need to be examined.

The work of Morton and Frith (1995) proposes a causal model of developmental psychopathology. Frith (1995) uses this model in order to address the multi-faceted aspects of dyslexia. In Frith's (1995) causal model framework dyslexia can be explored through three different levels: biological, cognitive and behavioural (Figure 2.1). The model also recognises the role of the environment and culture in interacting with these three levels. This model underpins the 'dyslexic system' framework discussed in Section 3.2.

The model aims to explore and explain the differing perspectives of dyslexia by addressing previous paradoxes in dyslexia definitions. Frith states that "for a full understanding of dyslexia we need to link together the three levels and consider the impact of cultural factors which can aggravate or ameliorate the condition" (Frith, 1999, p.211). Therefore, when considering dyslexia, Frith would argue that it is important to understand the biological, cognitive and behavioural factors. Dyslexia can be viewed as a

complex causal chain from biology, to cognition, to behaviour, consistently interacting with the environment at each level. Consequently, it is relevant to argue that all three levels of explanation should be combined for a full understanding of dyslexia. Therefore, the key concepts at each of these levels will now be briefly explored. This will be followed by a discussion of the advantages and disadvantages of understanding dyslexia at each level.

Figure 2.1 Causal modelling framework of dyslexia

	Biological
Environment	Cognitive
	Behavioural

(Adapted from Frith, 1999)

2.3.1 Biological

Acquired and developmental dyslexia. As previously explored when examining the history of dyslexia, the first research into the phenomenon compared those who may have developed dyslexia, to those who had acquired it. To date 17 types of developmental dyslexia have been identified, these types of dyslexia show symptoms that are very similar to that of acquired dyslexics. This suggests an initial biological origin of developmental dyslexia symptoms. An example of one of these comparisons was conducted by Castles, Bates and Clotheart (2006) who showed similar symptoms of 'reading without meaning' in both acquired dyslexic and developmental dyslexic participants. Identification of different types of dyslexia in their developmental forms and matching these with acquired forms also allows researchers to pinpoint areas in the brain which may be involved in the outcome of different symptoms (Zoccolotti & Friedmann, 2010).

Structural brain differences. Original work into the brain structure of those with reading difficulties took the form of post-mortem studies. Within the brain there are two types of tissue: white matter and grey matter. The grey matter is the section of the brain than contains the cell bodies, dendrites and axon terminals of neurones, therefore, most of the key functioning in the brain happens within the grey matter. The white matter is made of axons

and connects different parts of the grey matter. In 1968 Drake conducted an autopsy on a boy with reading difficulties. He found that there was some abnormality in the neurones in the white matter of the brain. Building upon this Geschwind and Levitsky (1968) suggested that "the presence of small brain abnormalities caused by delayed lateralization of language which in turn resulted in impaired acquisition of reading" (Elliot & Grigorenko, 2014, p.92). Further post-mortem studies have shown various differences in the structure of the brain in patients who had reading difficulties (Finch, Nicolson & Fawcett, 2002; Galaburda & Kemper, 1979; Galaburda, Menard & Rosen, 1994; Livingstone, Rosen, Drislane & Galaburda, 1991). These add to the hypothesis that reading difficulty is related to brain structure. In particular, it is suggested that during neural migration, the necessary neurons do not reach their normal targets. Further post-mortem studies also suggested that the dyslexic brain does not show the same asymmetry that is shown in the 'average' (≈65%) human brain (Geschwind & Levitsky, 1968). However, post-mortem studies show obvious methodological weaknesses such as the individuals' behaviour before they were deceased not always being accurately recorded and the sample size being small.

Yet, as science evolved, so did the means to examine brain structure. Techniques such as magnetic resonance imaging (MRI) mean that it is possible to visualise the brain structure of living participants. Work using such methods has confirmed the results of previous post-mortem studies showing a number of abnormalities in the brain structure of those who show difficulties reading. Elliot and Grigorenko (2014) summarise this research and state that those with reading difficulties show "abnormalities […] in the planum temporal, corpus callosum and cerebellum" (p.94).

However, one issue with this research is that while findings show clear brain differences in those who have difficulty reading, it does not specifically draw upon comparisons between those that are dyslexic and those that are not. This means that while areas that are important for reading have been identified, what makes one person dyslexic and another poor at reading is unclear.

Functional brain differences. Further insight into the biology of dyslexia, has come with the advance of methods to study the functional brain.

Functional imaging allows researchers to detect changes in the chemical composition, metabolism and blood flow in specific areas in the brain. As reading involves brain processing, functional imaging allows investigation into which areas are involved in these processes. Consequently, differences in those who have developed reading normally, and those who have not, can be examined. Qualitative reviews of research into the area have shown aberrant activation patterns in the language network within the left hemisphere (Demonet, Taylor & Chaix, 2004; Shaywitz & Shaywitz, 2005). In particular, left-posterior brain systems which are involved in the integration of information from the auditory and visual networks have been found to be impaired (Shaywitz & Shaywitz, 2008). Peterson and Pennington (2015) summarise research of functional brain differences and state that

> consistent under activations have been reported in two posterior left hemisphere regions; a temporoparietal region believed to be crucial for phonological processing […] and a occipitotemporal region, included in the so-called visual word form area, which is thought to participate in whole word recognition. Abnormal activation of the left inferior frontal gyrus is also commonly reported (p.2,001).

Furthermore, a quantitative meta-analysis of imaging studies confirms an under-activation in the left hemisphere of the brain (Richlan, Kronbichler & Wimmer, 2009). However, in order to identify the differences of a dyslexic cohort within the studies, those with dyslexia need to be matched and compared with those without dyslexia according to reading ability and reading experiences. This would allow the differences that 'dyslexics' hold that poor readers do not hold to be identified. To date, "studies attempting to control for reading experience are only partly consistent with each other and with MRI published work" (Peterson & Pennington, 2012, p.2,002). Furthermore, Elliot and Grigorenko (2014) highlight that a major problem with brain imaging studies is an inconsistency in how the dyslexia group are identified. Often those classed within the dyslexia group are those whose reading is below the 25th centile, therefore, once again, the differences recognised may be the differences shown by poor readers, rather than dyslexics.

Genetics. Like the structural and functional aspects of dyslexia, the causes of dyslexia are also multifaceted. Mirroring the historical 'nature vs. nurture' debate, the causes of dyslexia are associated with both genetic and environmental risks. The heritability of dyslexia can be tested by issuing behavioural tests to family members with varying degrees of genetic likeness (e.g. identical and fraternal twins) and investigating the correlations between their behavioural traits and their genetic similarity. If those who are identical in genetics show identical behaviours, then it can be suggested that the tested behaviour is a result of genetics. Whereas, if those who are genetically identical show different patterns of behaviour, this suggests that some aspect of the environment is affecting this behaviour. Grigorenko (2004) reviewed this research and concluded that "there is a substantial genetic contribution to developmental dyslexia and reading-related processes" (p.286). Differences in performances in different reading-based tasks fluctuate from being 40% heritable to 74% heritable (Grigorenko, 2004), therefore suggesting some component of heritability in all reading tasks tested.

With advancing understanding of genes and genomes it has been possible to identify six candidate genes that have been found to be associated with dyslexia (Kere, 2011). From studying the effect of these genes in animals, it appears that four of these have an effect on neural migration and axon guidance. This therefore, builds on previous structural brain studies which have suggested that dyslexia may be due to axons not reaching their target destination during neural migration. However, due to the fact that research exploring genes is still being developed, while these genes have been identified their relationship with dyslexic-specific symptoms is not yet clear. Furthermore, McCardle and Miller (2012) note that:

> Genes are important, but they are not the whole story; they are not a final determination. The environment in which a child is raised, the parenting, nutrition, healthcare, peer relations and education […] can influence the expression of those genes. These factors can also influence in ways that are not fully understood the plasticity of the nervous system set in motion by those genes (p.336).

This suggests that due to brain plasticity, the child's environment may also affect their brain structure. Therefore, whilst it is important to investigate the heritability of dyslexia, it is also important to determine the environmental factors that may also be associated with dyslexia and consider how these in turn may influence brain structure and functioning. Section 3.2.2 will explore the interaction between genes and environment.

Examining dyslexia through the biological lens. As genetics and neuroscience approaches grow, in the future, it may be possible to simply diagnose dyslexia without accounting for behavioural or cognitive signifiers. Miles (1995) believed that in order to distinguish between dyslexia and reading difficulty, assessments of dyslexia should include a neuropsychological evaluation. This would suggest that 'dyslexia' exists in a pure form and is diagnosable due to the presence of biological diversities. This could be seen as highly reductionist as the effects of the environment and individual factors are not taken into account.

On the other hand, the biological underpinning of human development needs to be acknowledged. Neuroscience has shown how "biological, social and psychological experiences translate into changes in brain structure" (Shah & Mountain, 2007, p.375). Therefore, although it may be considered 'reductionist' it could be argued human experiences can be explained through the lens of brain functioning. If we accept this view then it would be possible to use a 'scientific process' to look for the aforementioned brain structure differences, brain functioning differences or specific genes in order to identify people as dyslexic. It would then need to be assumed that individual differences come from variances in brain functioning alone.

However, neuroscience tells us that brains adapt due to different experiences (Buonomano & Merzenich, 1998). This brings into question whether differences between dyslexics and non-dyslexics are genetic, a consequence of experience, or both. Therefore, perhaps the scientific biological model is too reductionist in making diagnosis based on scientific method alone. There can be seen to be a large gap between a person's biology and their behaviour meaning that external factors can have a large influence on the clinical picture (Frith, 1999).

Furthermore, much of the work into biological factors associated with dyslexia investigates brain correlates of poor reading. Therefore, while looking at dyslexia through the biological lens offers a good understanding of the brain structure and functioning involved in reading, it does not separate a 'dyslexic' subcategory. Therefore, at present, brain imaging may not be able to offer diagnosis based on brain structure and functioning alone. Consequently, while there may be evidence of the neurological underpinnings of dyslexia, this thesis aims to question how these may interact with the environment and lead to a diagnosis of dyslexia.

While research has provided evidence that reading difficulties are biological in nature, it could be argued that what makes one person dyslexic, and another someone who struggles with reading, could be down to each individual's environment. This would mean that dyslexia is not a single biological aspect, but a system which can be shaped by the environment. Chapter 3 discusses what aspects of the environment could interact with these biological precursors to reading difficulty and result in someone being labelled with dyslexia.

Neurodiversity. Another biological perspective that is beginning to emerge in the literature around dyslexia is the concept of neurodiversity. This is the idea that diverse neurological conditions are the result of natural human variation rather than a disorder or deficit. Whereas the above biological explanations look for explanations in which those with dyslexia show differences or deficits when compared to those who are not dyslexic, the neurodiverse model suggests that trying to understand dyslexia, and other conditions, by looking for weaknesses and difficulties is ineffective. Rather, diversities are accepted as being a natural difference and should not be seen as a problem to be found and cured.

The impetus for this understanding came from the 'autism rights movement'. This movement rejects the idea that any neurological differences can be, or need to be, treated. Applying this concept to dyslexia Cooper (2006) states "dyslexia is an experience that arises out of natural human diversity […] and a world where the early learning of literacy, good personal organisation, and working memory, is mistakenly used as a marker of intelligence" (p.24). Therefore, it could be argued that we are all

neurodiverse, it is the social context that determines whether the diversity is understood as a disability.

The neurodiversity model of disability has been used to explain why many people with dyslexia show 'overlapping conditions' with other diagnoses. For example, many individuals with attention deficit hyperactivity disorder (ADHD) are also diagnosed with dyslexia, dyspraxia or Asperger's (Colley, 2009). It is argued that individuals may have a particular neurodiversity, which presents with different 'symptoms' in different people. This will then interact with the environment and lead to a particular diagnosis. Cooper (2010) gives the example of difficulties in sequencing: if the difficulties appear to affect sound processing then an individual may be diagnosed with dyslexia, however, if they effect muscle control then they may be diagnosed as dyspraxic. Therefore, placing different labels on these individuals would be misleading as it gives the impression that each diagnosis is a separate problem with a distinctive cause.

This gives weight to the argument, prominent within the dyslexia debate, which is not to diagnose with dyslexia. Armstrong (2011) argues that "we need a new field of neurodiversity that regards human brains as the biological entities that they are and appreciates the vast natural differences that exist from one brain to another" (p.225). By viewing dyslexic people in this way we can appreciate the different ways that dyslexic people learn, and accommodate for these in the same way that we accommodate for other differences between people. However, from looking both at the historical and more modern theories of dyslexia, dyslexia currently tends to be understood as a standalone condition. Therefore, it is important to question whether removing the label of dyslexia, and instead, viewing individuals as neurodiverse, would be beneficial to the individual.

2.3.2 Cognitive

Phonological deficit hypothesis. The phonological deficit hypothesis is the dominant theory in dyslexia understanding. In 1971, Liberman found that there was a relationship between human speech and phoneme awareness. He made the connection between reading difficulties being linguistic in origin

and specifically highlighted the misuse of phonemes. Phonemes are the smallest unit of sounds that distinguish one word from another. For example, 'cat' differs in one phoneme from 'cut'. The phonological deficit hypothesis was developed by Snowling (1981) who found that dyslexic individuals showed more difficulty with complex phonological patterns than non-dyslexics. Phonological awareness refers to "the ability to attend to and manipulate sounds in words" (Peterson & Pennington, 2012, p. 1,999). The phonological theory of dyslexia suggests that for accurate word recognition, we need to be able to make letter-sound correspondences. Phonological awareness is needed to retrieve the pronunciation of letters, and letter strings, and therefore read the word. Thus, through research, difficulties in phonological processing have been linked with dyslexia. Dehaene (2009) summarises the field and states that "the majority of dyslexic children appear to suffer from a deficit in the processing of phonemes—the elementary constituents of spoken words" (p.239). Due to this understanding, phonological awareness was found to be mentioned in 9 of 11 definitions of dyslexia (Caravolas et al., 2012). However, despite, its replicability in studies of dyslexic individuals, Castles and Friedmann (2014) challenge Deheane's statement that phonological processing is found in the majority of dyslexic children. They argue that to make this assumption it is assumed that "a) There is only one type of dyslexia; b) all dyslexic children have phonological impairments; and, c) these phonological impairments cause their dyslexia" (p.271). They argue that none of these statements are correct and therefore conclude that to understand dyslexia simply as an issue with phonological processing is "too limited and fails to acknowledge the complexity of this disorder" (Castles & Friedmann, 2014, p.280). A further caveat found in this hypothesis is that research has found a bidirectional effect of phonological skills and reading ability, whereby over time, poor reading may also cause poor phonological processing (Castles, Wilson & Coltheart, 2011). Therefore, to state that phonological processing difficulties may be the cause of dyslexia is flawed. Peterston and Pennington (2012) summarise that "although phonological deficits are standard in individuals with dyslexia, a single phonological deficit is probably not sufficient to cause the disorder" (p. 2,000).

However, the Rose Report (2009) states that "interventions promoting phonological skills are effective for teaching children with dyslexia" (p.58). Furthermore, Singleton (2009) conducted a review of interventions into dyslexia and states that of the phonological approaches to intervention "all point to the benefits of such intervention for children with dyslexia or learning difficulties" (p.39). Therefore, whilst there may be some flaws in the phonological deficit theory, the fact that interventions at this level are effective, suggests that it is an important area for those working with dyslexic individuals to understand. Consequently, it is important to enquire whether those working with dyslexic students understand phonological processing as a component of dyslexia.

Rapid atomised naming (RAN). Another common finding is that individuals with reading difficulties are slower at naming visual stimuli than those with normal reading ability. Typical measures of RAN assess the speed that the participant can name familiar items (e.g. letters, colours, numbers). Early research into RAN and reading found that there are correlations between the speed in which the items are named, and reading performance (Denckla, 1972; Denckla & Rudel, 1974). Wolf and colleagues then extended on this work and hypothesised that the reason that these skills correlate is that reading effectively requires the identification and matching of visual representations to phonological codes. Furthermore, both reading, and RAN requires the individual to perceive, interpret and name the stimuli at speed. Therefore, poor RAN is a result of a number of processing difficulties (Bowers & Wolf, 1993; Norton & Wolf, 2012; Wolf and Bowers, 1999). Cross-cultural work confirms that children with poor RAN speeds have poor literacy outcomes (Krasowicz-Kupis, Borkowska & Pietras, 2009; Papadopoulos, Georgiou & Kendeou, 2009). Kirby et al. (2010) found that RAN speed correlates with nearly all aspects of the reading process. However, RAN is more likely to be correlated with reading fluency than the decoding of sounds in words (Manis, Doi & Bhadha, 2000; Sunseth & Bowers, 2002).

An issue with suggesting that RAN is specifically associated with dyslexia is that "there remains considerable uncertainty about the exact nature of the cognitive processes that underpin naming speed, and its

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relationship with the naming process" (Elliot & Grigorenko, 2014, p.54). As previously stated, a variety of processes are involved in the skill of RAN. Therefore, it may not be useful to simply state that RAN is a problem without investigating what process within this task is causing the problem. Therefore, their remains doubts about whether interventions which increase individuals RAN, will in turn improve reading performance (Norton & Wolf, 2012). However, as it has been found to correlate consistently with reading difficulty, it is commonly used in dyslexia assessment.

The double deficit hypothesis. In response to both research on phonological processing and RAN, Wolf and Bowers (1999) proposed the double-deficit model. Within this model dyslexics can be divided into subgroups: those with phonological deficits but not RAN deficits, those with RAN deficits but no phonological deficits, and those with both phonological deficits and RAN deficits. Within this model "the phonological deficits and the processing underlying naming speed are separable sources of reading dysfunction, and their combined presence leads to profound reading impairment" (Wold & Bowers, 1999, p.416). This theory suggests that to simply deliver phonics-based interventions would limit those in the latter two groups. Wolf and Bowers (1999) conclude that there are subgroups within the dyslexia category due to the skills of phonological processing and RAN being largely independent. They believe that "recognition of deficits in both phonology and the processes underlying naming speed leads […] to a more comprehensive conceptualisation of reading difficulties and their treatment" (p.432).

Support for this theory has come from research in different languages which has shown that those with a 'double deficit' in phonological processing and RAN show the most severe reading difficulties (Torppa et al. 2013; Wolf, Bowers & Biddle, 2000). However, research has been inconclusive about whether a subgroup that shows rapid naming deficits but does not show phonological deficits exists (Vaessen, Gerretsen & Blomert, 2009). Kirby, Georgioum, Martinussed and Parrila (2010) conducted a review of research into the double-deficit hypothesis and summarise that the hypothesis can be challenged in three ways "a) phonological awareness and rapid naming do not have an independent

contribution to reading; b) the double-deficit group does not systematically perform worse than the single or no deficit groups, and; c) some participants move from one diagnostic group to another over time" (p.348). Therefore, they conclude that while research shows that those with the most severe difficulties experience both deficits in phonological processing and RAN "definite conclusions should be made with some caution" (p.350).

Short-term and working memory. Short-term memory describes the passive storage of information in the memory, whilst working memory refers to the storage and processing of information. It is unsurprising that memory is related to reading, given that reading involves the constant decoding, storing and retrieval of information at speed. Research has demonstrated correlations between poor working memory and dyslexia (Smith-Spark & Fisk 2007; Jeffries & Everatt, 2004). Specifically, working memory plays an important role when decoding complex words as the reader is required to make the association between sounds and letters, whilst holding this information in order to build up the whole word (Conners, Atwell, Rosenquist & Sligh, 2001). Furthermore, both short-term and working memory are involved in reading comprehension as the reader is required to remember what they have read in order to gain meaning from the text. Swanson, Howard and Saez (2006) found that poor performance on working memory tests was more likely to be found in children who showed problems with both the decoding of a word, and with reading comprehension.

The Rose Review (2009) also specifies 'verbal memory' in its definition of dyslexia. The report states that this is "the ability to retain an ordered sequence of verbal material for a short period of time" (p.33). This is commonly measured in dyslexic assessments and involves the individual repeating a string of digits both forwards and backwards. Repeating the words forwards tests the short-term memory, while manipulating them and repeating them backwards involves the working memory.

However, whilst it is clear how short-term and working memory may contribute to reading difficulties, it is also important in a range of academic abilities. De Weerdt, Desoete and Roeyers (2013) found that working memory was significantly involved in both those with mathematical disabilities and reading disabilities suggesting "domain-

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general working memory problems in children with learning disabilities" (p.462). Therefore, whilst working memory may be a problem with learning difficulties as a whole, it is not sufficient to solely explain dyslexia. Furthermore, "there is little convincing evidence to support claims that working memory interventions can meaningfully impact academic performance in school" (Elliot & Grigorenko, 2014, p.63). This suggests that while memory undoubtedly plays an important role in reading, interventions which focus on the more important cognitive functions should be targeted to help those with reading difficulties.

Auditory processing. Links can be made between an individual's phonological awareness, and their auditory processing. It is logical that if auditory processing is impaired, a person may not be able to accurately correspond the sounds that they hear in words, with the phonemes that are reading. Earlier work by Tallal (1980) showed that auditory processing and reading were correlated. Therefore, it was suggested that poor auditory processing may impact understanding of phonemes and therefore hinder the acquisition of reading skills. Tests of this hypothesis involved playing participants two short sounds and asking them to correctly remember which order they were played in. This theory of the 'rapid processing hypothesis' was then expanded on when it was found that those with reading difficulties did not just show an inability to perform this task with rapid sounds, but also with longer sounds with different intervals (Ahissar et al., 2000; McArthur & Bishop, 2004). An alternative theory has been put forward by Goswami et al. (2002) that individuals with dyslexia perform worse in tasks of prosody. Specifically, this involves the recognition of the rhythm of words, and sensitivity to 'rise time' (described as the changes in amplitude at the beginning of sounds) (Corriveau, Goswami, & Thomson, 2010). Correlations with this sensitivity has been found with phonological skills and language skills (Corriveau, Goswami, & Thomson, 2010; Goswami, Gerson & Astruc, 2010).

However, this hypothesis has been criticised due to its lack of universality. Studies have found that only "about a third" of those with reading difficulties tended to show auditory deficits (Boets, Wouters, Wieringen & Ghesquiere, 2007, p.1,614). Furthermore, research has shown

that they are less prevalent in other languages (Georgiou et al., 2010; Georgiou, Papadopoulo, Zarouna & Parrila, 2012; Goswami et al. 2011). What's more, there is evidence to suggest that individuals who show normal reading ability have significant issues with auditory processing tasks (Halliday & Bishop, 2006; Landerl & Willburger, 2010), suggesting that auditory processing is not sufficient on its own, to explain reading difficulties. However, it may be the case that while some individuals may develop coping strategies to manage auditory deficits, those with dyslexia are unable to develop these strategies. This would suggest that auditory processing may be one of a complex set of aspects which may contribute to dyslexia. Finally, there is little evidence to suggest that interventions that improve auditory processing skills have a positive effect on reading performance (McArthur, Ellis, Atkinson & Coltheard, 2008; Pokorni, Worthington & Jamison, 2004).

Visual processing. As discussed in the history of dyslexia, early theories around dyslexia stipulate that dyslexia was a deficit in visual processing. The phrase 'word-blindness' linked the phenomenon of difficulty reading with problems with eyesight. With the advance of scientific research methods, these theories began to be replaced with theories about brain structure and functioning as the causes of dyslexia, rather than eyesight. However, the idea of dyslexia as a visual processing disorder still receives attention. In particular, this relates to the concept of 'visual stress' whereby a person may see a page differently due to distortions of print on a white background. Visual stress has been reported to cause reading fatigue, however, the symptoms can be somewhat overcome by the use of coloured overlays (Wilkins, 2003). Singleton and Trotter's (2005) research on visual stress suggests that whilst they did not find an aetiological connection between visual stress and dyslexia, their findings showed an interaction between the two conditions whereby "university students who experience high levels of visual stress are more likely to show improvements in reading rate with optimal colour if they also have dyslexia than if they do not have dyslexia" (p.375). This suggests that while visual factors are not the cause of dyslexia, some interaction between dyslexia and visual functioning may be present. However, Wilkins (2003) summarised the research in the area

and suggests that "the proportion of [dyslexic] children who benefit from overlays is similar to that in normal children" (p.50). Furthermore, Handler and Fierson's (2011) more recent study summarised scientific literature on the topic and suggest dyslexia and visual problems are unrelated:

> Vision problems can interfere with the process of reading, but children with dyslexia or related learning disabilities have the same visual function and ocular health as children without such conditions. Currently, there is inadequate scientific evidence to support the view that subtle eye or visual problems cause or increase the severity of learning disabilities" (Handler & Fierson, 2011, p.818)

Therefore, research that has explored the connection between visual stress and dyslexia has been inconclusive. Due to this, no formal definition of dyslexia acknowledges eyesight as being a component of dyslexia. However, due to the historical understanding of dyslexia, it is interesting to question whether dyslexia is still seen as an issue with visual processing.

IQ ability discrepancy. A common understanding of dyslexia is that the individuals' ability is masked by their poor literacy ability. Should this be correct, those with dyslexia should have a high intelligence quotient (IQ) with a low reading ability. However, meta-analyses show that there is no evidence to suggest that the difficulties discussed above (phonological processing, RAN etc.) show any preference according to IQ. In particular, they are not more apparent in those with higher ability levels (Fletcher, Lyon, Fuchs & Barnes, 2007; Stuebing et al., 2002; 2009). Furthermore, if dyslexia were to be understood as a difficulty that effects only those with a higher ability, it would mean that those with a lower ability who may also struggle with the same processing difficulties, will not be able to access the resources that they need, due to the lack of diagnosis. As a result, the idea that there is an IQ ability discrepancy has been removed from definitions of dyslexia. The Rose (2009) definition states that "dyslexia occurs across the range of intellectual abilities".

However, Elbeheri and Everatt (2009) argue that social and political discourse around dyslexia still accepts that a pen-picture of a dyslexic person is a person with an IQ ability discrepancy. Furthermore, tests of IQ

are still common practice within a dyslexia assessment. In their report on assessment of SpLDs, England's Department of Education and Skills (DfES, 2005) stated that "although a discrepancy between underlying ability and attainment in literacy skills is not a diagnostic criterion […] where such discrepancies do exist, they provide further supporting evidence" (p.3). In correspondence, in a survey of assessors' perspectives on dyslexia 44% indicated that the ability discrepancy was a necessary criterion for dyslexia diagnosis (Ryder & Norwich, 2018). Therefore, although not an official prerequisite of dyslexia, it could be argued that this discrepancy definition is still very much embedded in the discourse and practice around dyslexia.

Examining dyslexia through a cognitive lens. Frith (1995) implies that the link between the biological level of dyslexia, and the behavioural symptoms shown, are issues at the cognitive level. Therefore, issues at the cognitive level could be said to be caused by differences at the biological level and explain issues at the behavioural level. However, as the above discussion has shown, the picture of dyslexic individuals' cognitive profiles is complex. While phonological processing has offered the best explanation so far, it is not enough to simply view dyslexia as a phonological processing issue alone.

Furthermore, there are difficulties in using measures at the cognitive level to diagnose dyslexia. For example, it is important to be aware of discrepancies in what a cognitive test intends to measure and what it actually measures. For instance, as discussed, working memory and phoneme awareness are said to be associated with dyslexia. Tests to measure these attributes are often included in dyslexia assessments. However poor performance in these tests could also be indicative of difficulties in aspects such as auditory and visual discrimination (Frith, 1999).

In addition, measures to examine a person's cognitive processing are tested by looking at their behavioural response to certain tasks. Therefore, cognitive tests may be influenced by outside 'noise'. This could come in the form of the person's mood, the time of the test, or simply the order that the tests are presented in. Consequently, it is difficult to state that the poor

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performance on a test is simply down to the person having a deficit in this area of cognitive functioning.

Another challenge for describing dyslexia at the cognitive level is that such definitions struggle to account for individual differences. It is generally accepted that dyslexia is distributed evenly across the population, affecting 5-15% of people (Elliott & Grigorenko, 2014). Therefore, a description of dyslexia may need to take into account differences in the population. It is accepted that "age, sex, ability, motivation, personality, social support, physical resources, instructional systems, the nature of the language and orthography- all play a role [in cognitive differences]" (Frith, 1999, p.200). Consequently, trying to organise people into 'subgroups' in order to look for similar cognitive traits in different groups would be very challenging on many levels, mainly because the idea that people can fall seamlessly into different categories is an idealised one. For this reason, it is of no surprise that nearly half of the assessors in Ryder and Norwich's (2018) study of assessor perspectives, indicated that the cut off points in psychometrics tests were arbitrary.

However, the knowledge that dyslexia is associated with phonological processing has allowed effective interventions to be developed. Therefore, it could be argued that an understanding of dyslexia at a cognitive level is the most useful for addressing the problems shown in people with dyslexia. This leads us to question whether or not those working with dyslexic students are aware of the most effective interventions for their dyslexia students.

2.3.3 Behavioural

Elliot and Grigorenko (2014) state that "at the behavioural level, debate rages as to where there are clear signs, or symptoms, of dyslexia as something other than a reading disability" (p.37). As discussed in the history of dyslexia, it is traditionally thought of as a problem with reading. The DSM-5 and ICD-10 classify dyslexia under reading difficulty. Furthermore, as shown in the above discussion of biological and cognitive traits, reading difficulty is often used as an indicator of dyslexia. In a study of the perspectives of assessors of dyslexia Ryder and Norwich (2018)

found that the most commonly recognised characteristic for dyslexia diagnosis was past and present literacy difficulties. However, Snowling (2008) has pointed out many other traits that may be associated with dyslexia at various stages of development (Table 2.1). Furthermore, while most assessors noted that literacy difficulties were necessary for diagnosis, 31% and 37% considered current or past difficulties as not necessary for a diagnosis (Ryder & Norwich, 2018). This suggests some discrepancies in the importance of the behavioural aspects associated with dyslexia.

Spelling. Whilst dyslexia may be commonly associated with reading, other literacy-based skills are also thought to be affected by dyslexia, in particular spelling. Given that dyslexia has been strongly associated with phonological processing and the ability to recognise and correctly interpret phonemes, it is of no surprise that the those with dyslexia have also been found to struggle with spelling: an activity that requires effectively stringing together different phonemes. Caravolas, Hulme and Snowling (2001) conducted a longitudinal study of British school children in their first three years at school. They found that phoneme segmentation and letter sound knowledge were precursors for spelling ability. Furthermore, poor early spelling ability, predicted poor reading ability, however, early reading ability did not predict later spelling ability. Therefore, they conclude that "encouraging beginner spellers to produce phonologically plausible spellings […] may help them to lay the foundations for the development of reading as well as spelling" (Caravolas, Hulme & Snowling, 2001, p.771). This suggests that spelling may be equally as important as reading in investigating and understanding dyslexia. Furthermore, Ouellette and Sénéchal (2008) found that tasks which increased children's spelling ability, had positive effects on their reading ability; further suggesting a strong association between spelling and reading.

Examining dyslexia through the behavioural lens. An option in providing a definition of dyslexia is to simply characterise it by saying that it concerns those who, despite appropriate resources, struggle with reading. However, as touched upon, reading is not the only skill that may be affected if a person has dyslexia. A further issue with this perspective is that a person's

reading ability tends to increase over time. Therefore, the criterion of being poor at reading is much harder to fulfil if diagnosing at a later age.

The Rose definition specifies that a way to define dyslexia can be when a person does not respond to intervention (Rose, 2009, p.10). However, research around dyslexia has shown that good quality teaching can help individuals with dyslexia. For example, the Sound-Linkage Programme (Hatcher, Duff, & Hulme, 2014) is highly regarded as a successful programme in helping children with dyslexia learn to read. Therefore, if you are going to understand dyslexia as an impairment with reading, it would be a requirement to gain information about the teaching and help that the child has already received.

A further issue with defining dyslexia at the behavioural level is that the behavioural symptoms of dyslexia vary between languages. For example, the English orthography is relatively unclear in comparison to Welsh which has a more transparent orthography. Therefore, dyslexia manifests in different ways depending on the language. English speaking dyslexics tend to struggle more with spelling and reading different sounds (e.g. a, ay, ai and ei can all be used to make the same sound) whereas Welsh speaking dyslexics struggle more with grammar and letter mutations. Often a Welsh speaker's dyslexia is not picked up until they start to read and write in English (Spencer & Hanley, 2003). Therefore, to define dyslexia on reading ability would isolate languages with different orthographies.

2.3.4 Summary of modern theories

While substantial research has been carried out into the biological, cognitive and behavioural correlates of dyslexia, much of this research has been challenged. Firstly, research has often failed to show clear differences between those who are dyslexic, and those who are poor at reading. Furthermore, of the aspects discussed, none are sufficient explanations of dyslexia alone. This suggests that, should dyslexia be different to reading difficulties, it is a complex mechanism, both in its underlying causes and in the symptoms that those with dyslexia present.

However, research has shown that certain interventions, particularly those in the area of phonological processing have benefits for those with

dyslexic-like symptoms. Therefore, while the research has been unable to clearly define a dyslexic subgroup, it has offered a way forward in effective reading intervention.

2.4 Dyslexia as a social construct

The previous sections drew attention to potential ambiguities around how dyslexia is understood, thus leading us to question the extent to which we can claim dyslexia exists in a natural form and how much of it is socially constructed? Hacking (1999) describes two phenomena. Firstly, an 'interactive kind' is a phenomenon that is created once a concept of it has been formulated. Secondly, an 'indifferent kind' is a phenomenon that does not change due to being classified or labelled, and therefore, acts in the same way regardless of the presence of a label. Interactive kinds tend to be studied within the social sciences, whereas indifferent kinds would be more regularly found in the study of natural sciences.

Dyslexia can therefore be considered in the context of both an indifferent and an interactive kind. As explored above, much research has been conducted into the biological and cognitive aspects of dyslexia. Should there be conclusive recurring biological, cognitive or behavioural diversity found in all people showing dyslexic symptoms, then perhaps it would be possible to claim that dyslexia is an indifferent kind which affects the person in the same way, regardless of how it is labelled and understood. However, as discussed, the understanding of dyslexia is much murkier than this: the definition of dyslexia has changed over time; it is difficult to say that all those with dyslexia show the same diversities; and, the differences between dyslexia and reading difficulty are highly contested. Therefore, dyslexia could be considered an interactive kind.

Furthermore, Hacking (1999) defines an interactive kind as "a kind in which the humans classified may indeed change through the looping effects, because of the ways in which the people classified react to being classified" (p.119). Thus, suggesting that those classified as dyslexic may react to being dyslexic by confirming the expectations about what dyslexia is. Williams (2009) also suggests how aspects of the social world can have real impact on an individual. He states that "physical phenomenon cannot

think themselves into existence, but a person labelled [dyslexic] by a researcher or policy maker can come to regard themselves as such" (Williams, 2009, p.1). Therefore, while the label of dyslexia may not be a physical phenomenon, labelling someone with dyslexia may impact what they believe about themselves, and therefore, may have very real consequences for those that are labelled with it. Consequently, consideration of the social aspects of dyslexia is needed, both in how they may contribute to the nature of dyslexia and how the presence of the dyslexia label may have social consequences. The following chapter will explore this social context of dyslexia.

2.5 Summary of Chapter

At present, in the UK, individuals are commonly being diagnosed with dyslexia. This suggests that this is a recognisable condition which can be identified by assessments. However, from reviewing what dyslexia is, the picture is arguably less clear than we are made to believe. Frith (1995) believed that knowledge of biological, cognitive and behavioural aspects of dyslexia are needed for a good understanding. As explored, there are issues in defining dyslexia at each of these levels alone. Frith (1995) suggests that combining all three levels means that "we can at least start to trace a path from brain abnormality, to cognitive deficit, to behavioural sign" (p.9). Therefore, in order to distinguish between poor readers and dyslexics it is important to refer to a developmental disorder which presents across all three levels.

However, while this may offer a potential solution, there are also issues in pinpointing what those conducting research into dyslexia believe it to be. Within the research who is included in the 'dyslexic' group is not consistent. Whilst academics have pinpointed clear biological and cognitive factors that are involved in reading, what has been unclear is how these aspects impact those with dyslexic but not others who are struggling to read. This leads to consideration of how much of dyslexia is due to underlying biological and cognitive diversities, and how much as an aspect of the social world.

The following chapter will examine the social aspects that may also be involved in dyslexia, and the potential social consequences of dyslexia on the individual.

CHAPTER 3

The Social Reality of Dyslexia

3 | The Social Reality of Dyslexia

Whilst the previous chapter explored the history and suggested 'symptoms' of dyslexia, it is also important to investigate the other aspects that are involved in dyslexia, the environment in which dyslexia occurs and the impact that this may have on the individual.

The first part of this chapter looks at the relationship between dyslexia and self-concept. As suggested by Hacking (1999) those classified may react to this classification. Therefore, it is also important to consider the social consequences of the dyslexia classification.

Secondly, as discussed in Section 2.1, due to the ambiguities and disagreement about what dyslexia is, it could be argued that dyslexia, in part, may be the result of environmental actors outside of the biological, cognitive and behavioural aspects discussed. If this is the case it raises questions about whether there is one thing such as dyslexia or whether it is in some way socially constructed. Therefore, it is important to consider the environmental factors that may be involved in constructing dyslexia. As suggested in Frith's (1995) model of dyslexia, it is important to consider how the environment may interact with the biological, cognitive and behavioural aspects of dyslexia. The theoretical models of Bronfenbrenner (1979) and complexity theory will be used to understand how the biological and cognitive aspects of dyslexia may interact with the child's environment and result in what we know as dyslexia. Following this, the chapter will explore previous research that has investigated the potential actors that may influence the relationship between dyslexia and self-concept, whilst providing justification for the need for the current research.

3.1 Relationship between dyslexia and self-concept

Before examining the results of research which investigates the relationship between dyslexia and self-concept, it is important to define this concept. In a meta-analysis of research into the effects of learning difficulties on self-concept, Zeleke (2004) points out that self-concept is multi-dimensional. Terms such as 'self-esteem', and 'self-worth' could be used interchangeably with 'self-concept', in describing "one's global sense of well-being as a

person and general satisfaction with oneself" (Zeleke, 2004, p.146). A particular area of interest for research focusing on dyslexia is its effect on academic self-concept. Whilst there may be a number of factors that contribute to a person's overall sense of self, individuals with dyslexia, may feel particularly inhibited with respect to academic performance. In Zeleke's (2004) meta-analysis of research into dyslexia and self-concept, whilst only 30% of the studies included found a difference between those with learning disabilities and their normally attaining peers on general self-concept, 89% of studies found lower academic self-concept in the learning-disabled groups. Therefore, while this overview of the research will explore the effect of dyslexia on varying aspects of self-concept, the research will aim to examine its effect on academic self-concept.

Slee (2011) argues that in the global West, academic achievements are held in more esteem than other forms of attainment, for example, being practical or creative. This expectation may interact with the individual's academic ability and consequently, it may be expected that those with dyslexia hold a lower academic self-concept, or general self-concept than those who are not struggling in academia; this has been reinforced by various research studies. From examining the literature, there appears to have been two key research methods that have been employed to study this phenomenon. The first of which is interviews. Glazzard (2010) conducted semi-structured interviews with nine 14-15 year olds who had received an official diagnosis of dyslexia. He reported the key themes that emerged from these interviews were students feeling stupid, disappointed and isolated due to their dyslexia. However, he also suggests that early diagnosis is necessary to alleviate low self-esteem. Lithari (2018) conducted interviews with 20 participants of various ages who had a diagnosis of dyslexia. She concluded that "dyslexia has a profound effect on identity construction, since it fractures academic attainment, which is a cultural expectation" (Lithari, 2018, p.13), therefore, suggesting that the negative experiences of those with dyslexia are due to, as Slee (2011) suggests, the cultural emphasis that is placed on academic performance in our society. Doikou-Avlidou (2015) also conducted interviews with dyslexic university students in Greece. He questioned their academic experiences and found that dyslexia had given rise to negative feelings at all levels of the

participants' education, but they also mentioned strengths and coping strategies that they had developed to help to deal with their dyslexia. Additionally, Leitão et al. (2017) interviewed 13 children with dyslexia and 21 parents of children with dyslexia. They suggested that those with dyslexia had "negative self-perception centring on lack of academic skills and frequent comparison to their peers" (Leitão et al., 2017, p.326). Participants particularly reported experiencing this before their dyslexia diagnosis.

In addition to interviews, the second key research method to emerge from the literature is research employing standardised questionnaires to compare different aspects of self-concept between those with dyslexia and a 'non-dyslexic' control group. Alesi, Rappo and Pepi (2012) compared 56 children who had "specific reading decoding disabilities of both accuracy and speed" (p.955) with those who had comprehension difficulties, maths difficulties and a 'normal' control group. Those with any of the aforementioned difficulties showed lower ratings of scholastic self-esteem on the 'Multidimensional Test of Self-esteem' (Bracken, 1992) than the children whose learning was normal. However, there were no significant differences between the 'dyslexic' group and the other learning difficulties, suggesting that low self-esteem may be a product of struggling academically, rather than the dyslexia itself. Furthermore, Eissa (2010) conducted both interviews and questionnaires (Youth Self-Report Inventory; Hamilton rating scale of depression; Hamilton rating scale of anxiety) with 35 adolescents who had either been diagnosed with dyslexia or had shown consistent poor reading. Their results were compared with a group of 'typical readers'. Results showed that those with reading difficulties had lower feelings of self-esteem and well-being. However, again, these results cannot be attributed to dyslexia exclusively, but rather show the negative effects of struggling academically.

Results from both qualitative interviews and quantitative comparisons with 'typically developing' peers suggest a negative effect of struggling academically. However, the results do not add weight to the dyslexia debate, as it is not clear whether the negative effect is due to being diagnosed with dyslexia, or whether it is a result of struggling academically. Therefore, in an attempt to isolate the effects of a label, it is necessary to

compare groups who are labelled with dyslexia to those who are showing the same academic performance levels but are not labelled. A few studies have attempted this; for example, Polychroni, Koukoura and Anagnostou (2006) compared 32 10 to 12-year olds with their peers. The non-dyslexic peers were split into low-performance and high-performance subgroups. Results showed that the dyslexic group showed significantly lower academic self-concept than both the high-performance and the low-performance comparison groups. This suggests that there may be a negative impact of the label which is not due to low-performance alone. The authors suggest that further research should investigate this by looking at the impact of the label. Yet they also highlight that there were only a small number of participants in the low achieving comparison group, therefore, further research should replicate this study using a larger comparison group. Riddick, Sterling, Farmer and Morgan (1999) matched 16 dyslexic university students with 16 controls. Students were matched on the subject that they were studying at university and social background (father/mother's occupation). This design assumed that similar academic success and strength are needed to study each course. Results showed that compared to the control group the dyslexic group showed lower self-esteem, reported feeling more anxious, and less competent in their written work and academic achievement. This again suggests a negative effect of the dyslexia label, as opposed to underperformance academically. This is particularly interesting as the participants studied here had succeeded in getting into university, and yet still had negative feelings towards their academic ability.

However, in contrast, Rimkute et al. (2014) found that those with dyslexia had lower academic expectations and aspirations than those without dyslexia, however, once academic achievement had been controlled for, this relationship was no-longer significant. Thus, they stated that "adolescents with dyslexia have higher risk for lower academic achievement, which then leads to lower expectations concerning their future education" (Rimkute et al. 2014, p. 1,249). These results, strengthen the argument for the cause of the lower expectations being associated with previous academic achievement, as opposed to the dyslexia label directly.

Therefore, while the majority of research that controls for academic ability shows a relationship between the dyslexic label and low self-concept

the picture is far from clear. In order to better understand this relationship, it is important to consider factors that may be involved in the relationships. One potential within-child hypothesis as to why there may be a relationship between dyslexia and self-concept is that the biological precursors of dyslexia, share a biopsychosocial pathway with lower self-concept or wellbeing (i.e. an interdependent relationship between the biology and social aspects of dyslexia and wellbeing). However, Whitehouse, Spector and Cherkas (2009) compared monozygotic and dizygotic adult twins and found that there was no shared genetic origin for any link between dyslexia and anxiety. Therefore, concluding that environmental causes are the likely explanation for high correlations between dyslexia and low wellbeing. This is supported by, Jordan and Dyer (2017) who used data from the Millennium Cohort Study (MCS) to examine the well-being development of those with dyslexia. They compared those with dyslexia to those with dyslexia alongside another special educational need (SEN), those with SEN but no dyslexia, and those with no SEN at age 11. They found that those with dyslexia alone showed normal wellbeing before entering school, but upon starting school, their wellbeing worsened. This suggests that the negative effects of dyslexia become apparent on interaction with the academic environment. Yet, for other SENs, issues with wellbeing coincided with the indicators of the SEN prior to starting school. This therefore advocates that dyslexia alone is not a risk factor for low self-concept, rather, it is how the dyslexic individual interacts with their environment that results in a negative outlook.

Yet caution needs to be taken when attributing negative effects to environmental factors alone. Rimkute et al. (2014) found that dyslexia had a larger impact on the academic expectations of boys in particular. As boys are more likely to be diagnosed with dyslexia than girls (Arnett et al., 2017) differences could be simply be driven by males having lower academic self-concept than females, rather than as a result of dyslexia. Furthermore, there may be other correlates of dyslexia that may also correlate with self-concept that are not due to academic ability alone. For example, both social class (Rogers, Smith & Coleman, 1978; Trautwein, Lüdtke, Marsh & Nagy, 2009) and gender (Cokley, 2002; Marsh & Yeung, 1998; Rimkute et al., 2014) have both been found to be associated with differing levels of

academic self-concept. Therefore, it could be argued that if dyslexia is not evenly distributed amongst these populations it may impact the significance of the relationship between dyslexia and academic self-concept. Consequently, it is also important to take into account the other social demographic factors, not simply academic ability, that could also correlate with dyslexia, as these may also influence the relationship between dyslexia and self-concept. Thus, it is important to investigate what demographic factors, and environmental factors may impact the relationship between dyslexia and academic self-concept.

3.2 The dyslexic system: A conceptual framework

While the research discussed in Chapter 2 focuses on how the individual experiences dyslexia, it is also important to consider what environmental factors may also be involved in dyslexia, both in how they impact whether or not dyslexia is diagnosed, and how they impact the individual's academic self-concept post-diagnosis. Furthermore, in establishing whether dyslexia is an 'interactive' or 'indifferent' kind (Hacking, 1999) it is important to question that factors that are involved in dyslexia which do not stem from the 'natural sciences'.

To support the concept that the environment is important in dyslexia, Jerrim, Vignoles, Lingam and Friend (2015) suggest that genes can only explain 2% of the socio-economic gap in reading performance. This suggests factors other than biological aspects are important in determining educational outcomes. Furthermore, Friend, DeFries and Olson (2008) looked at moderators of reading disability and found that "genetic influence was higher and environmental influence was lower among children whose parents had higher levels of education" (p.1,124). This again suggests that other aspects interact with biological factors to influence the outcome of having a reading difficulty.

This idea is reflected in the results from Ryder and Norwich's (2018) study into assessors' perspectives of dyslexia. They found that while 75% of assessors believed that dyslexia stems from biological causes, 80% indicated that while environmental causes alone could not cause dyslexia

they could exacerbate it. Therefore, indicating interaction and interplay between biology and environment.

Furthermore, as suggested above, it is also important to consider how dyslexia interacts with self-concept, and whether it is the dyslexia label that is causing this relationship, or whether there are other correlates of dyslexia that are controlling this relationship.

In order to understand these complex relationships, it is necessary to situate them within a conceptual framework. Therefore, this thesis proposes the concept of 'the dyslexic system'. The basis of this system is the causal model developed by Frith (1995), as discussed in Section 2.3. Within this model, Frith proposes that it is important to understand how the environment interacts with the biological, cognitive and behavioural aspects of dyslexia. However, while Frith states that the environment is an important factor in understanding dyslexia, she does not theorise in great detail, the role the environment may play. A theory that explores how an individual's environment may contribute to child development is Bronfenbrenner's (1979) 'ecological systems theory'; this theory will now be discussed followed by a discussion of how complexity theory can also be used, to strengthen areas where the ecological systems theory is weak, and contribute to the conceptual formation of the 'dyslexic system'.

3.2.1 Bronfenbrenner's ecological systems theory

Whilst Section 2.3 explored what individual level factors may contribute to the portrayal of symptoms that may be associated with dyslexia it would be wrong to simply consider the dyslexic child alone, without taking into account the environment(s) with which they interact. Urie Bronfenbrenner's (1979) ecological systems theory can be drawn upon in order to explore how the child is a product of both their individual characteristics and their environment. This is a theory within the realm of developmental psychology, which has been used to explore how inherent aspects of a child interact with their environment to influence their development. The theory differs from many as it views the child as both a product of, and a contributor to, multiple interacting environments. Eysenck (2000) states that

the ecological paradigm is a beneficial way to look at child development for two reasons:

> First it helps to integrate the closely related areas of developmental and social psychology. Second it identifies more of the numerous factors that influence children's development than most developmental theories (p. 388).

Therefore, it not only considers the developmental aspects which describe the differences in the development of children with dyslexia, but it also takes into consideration social psychological aspects, by considering how an individual interacts with their environment. Bronfenbrenner (1986) defines this theory as:

> the scientific study of the progressive, mutual accommodation throughout the life course between an active, growing human being and the changing properties of immediate settings in which the developing person lives. [This] process is affected by the relations between these settings and by the larger contexts in which the settings are embedded (p. 188).

Figure 3.1 Ecological systems model
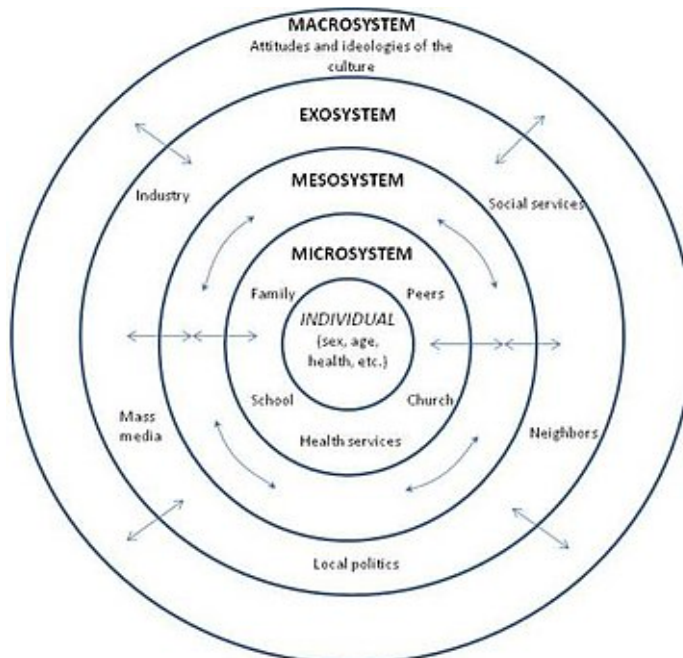
Bronfenbrenner's theory was in a continual state of development until his death in 2005 (Tudge, Makrova, Hatfield & Karnik, 2009). His

initial theory, published in 1979, revolved around a model which comprises of five layers of systems. Each system can both affect and be affected by the individual's development. Figure 3.1 shows the typical pictorial portrayal of the ecological systems model.

Individual. In the centre is the individual. Characteristics of the individual, including both their biological aspects and their personality, interact with the other layers in the system. Bronfenbrenner divided these characteristics into three types: demand (immediate stimulus to another person e.g. age, sex, race etc.); resource (mental and emotional resources e.g. experiences, skills, intelligence, and social and material resources e.g. educational opportunities, housing etc.); and, force (temperament, motivation, persistence etc.). Furthermore, in the bioecological paradigm, Bronfenbrenner and Ceci (1994) give a theoretical model of gene-environment interactions and how these may also shape human development. Whilst the ecological system suggests that the individual can be influenced by and can influence the environment, the bioecological system suggests that genetic material can also be affected by, and affects, the environment. Bronfenbrenner and Ceci (1994) state that "genetic material does not produce finished traits but rather interacts with environmental experience in determining developmental outcomes" (p.571). Therefore, while a person may carry the genetic potential to show a certain characteristic or behaviour, interaction with the environment is necessary to see this potential realised. Therefore, in the case of dyslexia, while a person may be genetically predisposed to show dyslexic symptoms, interaction with the environment determines whether this genetic potential is reached.

Microsystem. The microsystem is the closest system to the child and describes the immediate environment in which the child lives in the 'here and now'. Therefore, it includes the immediate organizations or individuals that the child interacts with at a given moment. These could include, for example, the child's family home, school class or friendship group playing in the street. The relationships are bidirectional meaning that the child may affect the microsystem just as those the microsystem may affect the child.

Mesosystem. The mesosystem is defined by the interrelationships that occur between different microsystems experienced by the child. For example, how the child experiences similarities and differences between home and school. This could include the child's awareness of the parents' attitude to education.

Exosystem. The exosystem comprises settings to which the child does not have access, but that could have a direct effect on the child's development. For example, settings in which policy and practice guidelines on education are made may influence how the teacher interacts with the child.

Macrosystem. The final level described by Bronfenbrenner is the macrosystem. This describes the cultural values of the society that the child lives within. For example, how norms and values within the culture may influence the child's development. In relation to dyslexia, this could be whether it is the norm within the culture to be diagnosed with dyslexia.

Overview of Bronfenbrenner. Bronfenbrenner suggested that interrelations among these nested environments can influence a child's development. This theory was then revised and refined over time and evolved into the bioecological model in which more emphasis was placed on the 'proximal processes' involved in development (Bronfenbrenner, 1995; Bronfenbrenner, 1999; Bronfenbrenner & Evans, 2000). It was suggested that these proximal processes are "the engines of development" (Bronfenbrenner & Evans, 2000, p. 188). An example of a proximal process in the developing child would be teacher-child interactions. Bronfenbrenner and Ceci (1994) suggested that it is through these processes that developmental potentials are actualised, and for this reason they exert a powerful influence on developmental outcomes. In addition to proximal processes, Bronfenbrenner also described distal processes. These are factors outside the immediate external environment, including internal forces (genes) and external forces (features of the education system or of the broader culture), which modify the proximal processes. Focusing on the wider and more distal processes, alongside the more immediate proximal

processes may provide a more complete understanding of the dyslexia system.

Consequently, looking at dyslexia from an ecological perspective considers not only the dyslexic child, but also what may be influencing them at school and at home (microsystem). Furthermore, it also goes as far to consider how political and cultural context may also have an influence on their development (macro-system). Therefore, it is not possible to adopt a within-child definition of dyslexia whereby the differences in the child alone are considered as the main causes of dyslexia. Rather, this theory would suggest that it is important to consider social factors and interactions to gain a true understanding of dyslexia. Consequently, within this model it is vital to understand interactions between individuals and their environment in order to understand the development of the individual.

Limitations of Bronfenbrenner. Bronfenbrenner's model is difficult to apply in research due to the fact that it requires an extensive range of ecological detail from which to build meaning that many actors in someone's environment need to be considered. Therefore, it does not acknowledge how it is, arguably, impossible to account for and measure all aspects of an individual's environment. As a result, the theory offers little on how to measure the impact of actors within the model. However, Bronfenbrenner's model is not designed to be testable but rather it offers a theoretical framework in which to examine development. Due to this, this chapter will now explore the use of complexity theory to aid in the understanding of the dyslexia system.

3.2.2 Complexity theory

It has been stated that:

> The ecological systems model of Urie Bronfenbrenner represents a useful theoretical framework for understanding the processes and interactions involved in student achievement, and that the dynamic, non-linear changes within these systems can be effectively understood by applying the mathematical models of complexity theory (Johnson, 2008).

Therefore, the systems suggested by Bronfenbrenner can allow an understanding that is it not just important to focus on the dyslexic individual, but also the environments that they are situated within. Furthermore, applying complexity theory within the Bronfenbrenner model means that the interactions between the individual and the environment are not simply viewed as cause-and-effect relationships, but allows understanding that these relationships are complex.

Complexity theory initially originated in the natural sciences and defines the "domain between linearly determined order and indeterminate chaos" (Byrne, 1998, p.1). It has been used by scientists to explain situations whereby a cause and effect situation cannot easily be determined. More recently, complexity has been applied to social science research; to infer a causal relationships in a social system may overlook the complexity that it exhibits. Therefore, according to complexity theorists, it is important to initially look at the 'bigger picture' before tracking the effects that may make up the system. Applying this to dyslexia, complexity theorists would argue that rather than looking for aspects that may cause dyslexic symptoms, it makes more sense to look at dyslexia as a bigger picture, and to include society within that picture. This contrasts to previous research into dyslexia which has tended to look for one, or even a combination of potential causes.

Complexity theory describes the social world as being made up of complex, open systems. Within these systems aspects within it will interact, "the interactions are multiple and multiply connected, and it is this multiplicity of the interactions through time that produces effects" (Haggis, 2008, p.167). Therefore, through these interactions emergent behaviours arise that would not arise without these interactions.

> Although the complexity of the social world, taken as a whole, could be conceptualised as being characterised by 'millions or billions of variables', such complexity could also be conceptualised as consisting of a large number of smaller, overlapping types of 'organised' (but open) systems. Cultures, discourses, practices, social groupings, institutions, and individuals could all be seen as 'open systems', which manifest different types of organisation (Haggis, 2008, p.165).

Take the example of eating an apple: a person may eat an apple due to biological reasons -- they are hungry and need the apple for nutritious reasons. However, cultural normative aspects may also influence whether they eat an apple, apples are commonly available and eaten in the UK. This may also be impacted by the financial value of apples compared to other fruit. Furthermore, historical factors may also influence whether the person eats an apple, they may usually have an apple while waiting for the bus, for example. Therefore, these circumstances interact and result in the outcome of a person eating the apple. There may be a large number of other factors that also influence this behaviour, however, the factors are not limitless, nor are they random. Therefore, to understand complex systems it is possible to look for specific forms of order that may periodically emerge from within the system.

Applying complexity to dyslexia.

Figure 3.2 A complex dyslexic system
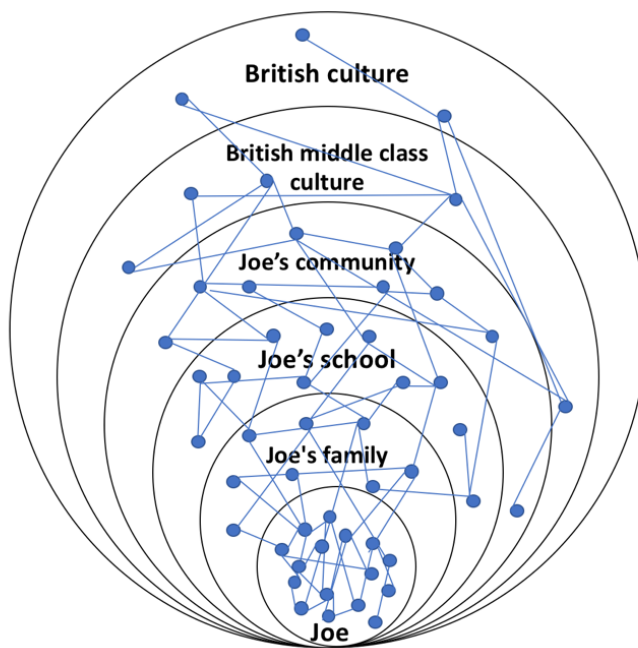
Figure 3.2 can be used to interpret how complexity could be applied to dyslexia. The circle in the middle represents 'Joe'. Within Joe there are biological elements such as his sex, genetic make-up, and predispositions. Included within these may be some of the biological and cognitive aspects that have been found to be related to dyslexia. Joe is constituted within his

family; therefore, he is partly constituted by the interactions that happen in his family. These may include the family structure (e.g. whether Joe has any siblings), their interactions with Joe's learning, their routines, and the emphasis they place on education. Yet, Joe's family is also constituted with its interactions with Joe, and his responses and behaviours, including his personality. Furthermore, both Joe and his family interact with Joe's school. Within the school come the norms placed on learning. The interactions with teachers in the school will both be affected by how Joe and his family present themselves and will influence Joe's own attitude toward learning.

Joe, his family, and his school, are all constituted in the community. This includes the norms and values that are passed on by the community. Also, within the community may be the interaction between parents in the community, and the resources that may be available for literacy support. Joe, his family, and his school also contribute to the interactions that make up the community. Similarly, the interactions which involve Joe, his family, his school and his community both partly constitute and are partly constituted by interactions with larger systems such as British middle class culture. This may include the norms of being diagnosed with dyslexia, whilst British culture places values on the skills of literacy.

For Joe to be diagnosed with dyslexia, a large number of interactions need to happen within this system. The symptoms that Joe may be showing may interact with many of these different levels. In some situations, this may result in Joe getting a diagnosis of dyslexia, whilst if other interactions took place, Joe may not receive this diagnosis. Within this model dyslexia is an emergent property of a complex system. Therefore, according to complexity theory, it does not make sense to look at dyslexia in the form of what it may be caused by, and also what behaviours it may, in turn, cause: "causation is too multi-dimensional, too fast, and in some senses […] too unpredictable to be a viable focus of attention" (Haggis, 2008, p.173). This provides justification for viewing dyslexia as a system which contains some, or many, biological and cognitive elements, but also interacts with the world allowing outcomes to change. Consequently, it is important to look for elements which may interact, to lead to a person being diagnosed with dyslexia, rather than looking for its causes.

While little research has been conducted which looks at dyslexia through this complex lens, King and Bearman (2011) investigated the likelihood of a child having autism due to differing macro-level aspects. Their aim was to understand the potential reasons why the prevalence of autism has increased tenfold in the US over the past 40 years. In order to understand this, they aimed to investigate "the way in which individual and neighbourhood characteristics interact over time to shape health outcomes" (King & Bearman, 2011, p.321). While they do not specify complexity theory directly, they demonstrate how "communities and institutions do not passively exert the same influence over time; rather neighbourhoods have different effects on different individuals at different moments in the autism epidemic" (King & Bearman, 2011, p.321). This research investigates the complex system of autism in the US. To study this phenomenon they used birth cohort and diagnostic information from California between 1992 and 2000 to create multi-level models to examine the probability of an autism diagnosis. Their results showed that along with individual level factors such as gender and birth weight increasing the probability of autism, community-level factors also drove this likelihood. "Children born to wealthier and more educated parents, living in wealthy neighbourhoods have the highest probability of obtaining an autism diagnosis" (King & Bearman, 2011, p.332). Furthermore, in a previous similar study, Liu, King and Bearman (2010) found that children who lived close to a child that already had an autism diagnosis were more likely to be diagnosed with autism, suggesting underlying social influence in autism diagnosis. In a short summary piece, Bearman (2013) questions "what if the sequencing phenomenon is to be found not in the genome but instead in a better understanding of the social and cultural factors that shape health?" (p.11) This, therefore, suggests that while a great number of resources are put into understanding the genetic and biological determinates of health aspects such as dyslexia and autism, perhaps equal attention needs to be given to the environmental factors which may be just as likely to alter the probability of diagnosis. Bearman (2013) goes further to state that "environments are settings in which genetic things can happen" (p.12) suggesting that environments and genes may interact with one another. Therefore, an understanding of this complex system is needed to begin to fully understand the condition in question.

3.2.3 The dyslexic system: Three models combined

Frith's causal model, Bronfenbrenner's Ecological Systems model, and complexity theory, all suggest that in order to understand a phenomenon (in this case dyslexia) it is necessary to look, not only at the individual, but also at the environment that they are situated within, and the interactions that take place within this environment. Tomlinson (2012) states that most analysis of SEN "focuses on the individual and familial deficiencies rather than the needs of the education systems, governments or economies" (p. 283), further highlighting the need to look beyond the individual when investigating dyslexia. For this reason, the current research will explore the dyslexic system: 'A complex system in which interactions between an individual and actors within their environment may contribute to both the identification of dyslexia, and the experiences of the dyslexic individual'.

Given the nature of a complex system, it is not possible to explore all possible actors within the dyslexic system. However, aspects that the literature indicates would be interesting to explore in their relationship with dyslexia will now be discussed with an aim to investigate how dyslexia may also be a product of the environments that the individual is situated within. This will provide more information on whether there is evidence for one thing such as dyslexia or whether it is a product of social environments.

Bronfenbrenner's systems offer a way to examine and understand the literature around the environmental actors within the dyslexia system, and how they may impact and be impacted by the individual. Therefore, potential actors within each of Bronfenbrenner's systems will now be explored.

3.3 Microsystem

The ecological systems model places emphasis on 'proximal processes' defined as the systematic interaction between an individual and their environment. Furthermore, complexity theory talks of the importance of interactions between actors in a system. Important interactions within the microsystem take place in the child's school and home environments. Two aspects from these environments will now be explored. Firstly, the presence of siblings will be explored in order to understand how this may impact

dyslexia. Secondly, as the current research is interested in academic development this section will look at the importance of interactions between teacher and child.

3.3.1 Sibling configurations

Research has shown that, within education, firstborns have an advantage over their later-born counterparts in both intelligence levels (Black, Devereux & Salvanes, 2011) and educational outcomes (Bagger, Birchenall, Mansour & Urzúa, 2013; Behrman & Taubamn, 1986; Booth & Kee, 2009; Black, Devereux & Salvanes, 2005; Hotz & Pantano, 2013; Iacovou, 2008; Kantarevic & Mechoulan, 2005; Kristensen & Bjerkedal, 2010). Theories have been proposed as to why this phenomenon occurs, such as parental investment. Explained simply, those with more older siblings will be worse-off since recourses are diluted, yet firstborns are in a preferable position as they experience a period of exclusive parental investment. In support of this theory, Price (2008) found that the first-born child received 20-30 minutes more quality time with their parent each day in comparison to a second-born child of the same age and circumstance.

This theory suggests how having an older sibling, or not, can shape a child's outcomes. This highlights the importance of looking at these aspects when understanding a child's development. The relationship between dyslexia and siblingship has, to my knowledge, been unexplored. Therefore, it is of interest to investigate how having siblings may impact the dyslexic system. Furthermore, Bu (2014) found that the relationship between being a firstborn child and academic outcomes, was mediated by academic aspirations. This suggests a relationship between siblingship and academic aspiration. If it is found that there is a relationship between dyslexia had having an older sibling, it could be argued that Rimkute et al.'s (2014) findings that those with dyslexia have lower aspirations could be explained by the fact that dyslexic children are not the firstborn in the family. Therefore, it is important to isolate this when looking at the effect of dyslexia on academic aspiration.

3.3.2 Teachers

A key theme that emerged from the interview research into dyslexia and self-concept is the effect of teachers on either aggravating or alleviating the negative effects of dyslexia on academic self-concept. Lithari (2018) found that a number of her participants had negative experiences with individual teachers. This was echoed in research by Humphrey (2002) who found that half of his dyslexic participants had been persecuted by teachers for their dyslexia related symptoms. Glazzard (2010) also highlights how participants spoke about how teachers had humiliated them. Leitão et al. (2017) reported that children were aware of the negative effects of lack of teacher knowledge, while parents of those with dyslexia spoke about the lack of teacher training and the negative impact of this. This is mirrored in the findings of Doikou-Avilidou (2015) who spoke of how

> teachers who were knowledgeable about dyslexia or had experience with pupils with dyslexia were more understanding and willing to help. Nevertheless, the students encountered negative attitudes on the part of their teachers such as lack of interest and understanding, lack of differentiated assessment and stigmatising behaviour much more often (p.138).

The fact that teachers' knowledge came out as a significant theme in the majority of interview studies into dyslexia and self-concept suggests that teacher understanding may be an important aspect that influences the correlation between dyslexia and low self-concept.

3.3.3 Teacher expectancy

Research into dyslexia and self-concept found that dyslexic participants often mentioned teachers as important figures in their experience of dyslexia. Therefore, it is important to investigate how teachers' opinions may influence the students' self-concept. 'Teacher expectancy effect' describes the phenomenon whereby a teacher's expectation leads to a change in student performance that matches their teacher's expectation. This effect was famously studied in the US by Rosenthal and Jacobson in 1968. This study, entitled 'Pygmalion in the Classroom', initially involved the experimenters administrating a non-verbal intelligence test to all the

children in an elementary school (ages 6 to 12). The children's teachers were told that the test was a test of 'Inflected Acquisition' and that it was being used to identify which children were likely to 'bloom' over the coming school year. By this they meant the students that were likely to show a sudden intellectual gain. About 20% of the students were randomly assigned this label. Therefore, "the difference between the children earmarked for intellectual growth and the undesignated control children was in the mind of the teacher" (Rosenthal & Jacobson, 1968, p.70). The experimenters then administered the same intelligence test one year and two years later. Results showed that the 'late bloomers' gained more IQ points than the control group both one year and two years later. Furthermore, the findings showed that teachers acted in a more hostile manner to those students who also showed intelligence gains, but who were not earmarked as bloomers. This study

> captured the imagination of the intellectual public and many social scientists, at least in part, because its message was clear and simple, and it seemed to provide scientific credibility and strong rhetorical ammunition for pundits, policymakers, social activists, and reformers (Jussim & Harber, 2005, p.134).

Consequently, the idea of the teacher expectancy effect is well known within educational research. These findings could be used to help explain the low academic self-concept in those with dyslexia. Instead of the label 'bloomer' teachers are given the label 'dyslexic' and may hold differing expectations for these children based on their understanding of this label.

However, there have been controversies over the initial findings of Rosenthal and Jacobson (1968). Jussim and Harber (2005) summarise the flaws of the study, which have been highlighted by various researchers. Firstly, although the bloomers showed an increased intelligence gain, the control students also gained in intelligence at a higher rate than would usually be expected. Consequently, the differences between the bloomers and the control group was not as dramatic as initially reported. Jussim and Harber (2005) report that there was, on average, a four-point IQ difference between the two groups. This corresponds to a correlation of r=0.15 and, therefore, would typically be characterised as a small effect size. Furthermore, while those in the first and second grade showed large gains in

IQ, those in the third to sixth grades did not show such dramatic gains, suggesting that the results cannot be generalised to all age groups. Thus, Jussim and Harber (2005) summarise that "the justifiable conclusions are considerably more modest than suggested by the overly dramatic manner in which the study has been frequently portrayed" (p.135). However, they do make clear that there is still evidence to suggest that teacher expectancy effects in the classroom are real. However, the expectancy effect may be due to the fact that teachers' expectations are simply accurate predictions of a student's ability, rather than that their expectations are becoming self-fulfilling (Jussim & Harber, 2005). Thus, perhaps the reason why students with dyslexia have low academic self-concept is due to their actual ability being low, rather than teachers influencing the students' expectations of their own ability (however, as described above, students with dyslexia have been found to show lower academic self-concept than those with matched academic ability).

Teachers expectancy effect is based around the concept of self-fulfilling prophecy. This idea was first developed by Merton (1948) who spoke of how erroneous beliefs about an individual can become true. Essentially, self-fulfilling prophecy states how social expectations may create social reality by causing people to act in a way that causes false beliefs to become true. Babad, Inbar and Rosenthal (1982) built upon the idea by distinguishing between 'Golem' and 'Galatea' effects. Golem effects describe a negative effect whereby the low expectations of others result in an individual confirming the negative expectations. Whereas, Galatea effects describe how high expectations result in positive improved outcomes, as shown in Rosenthal and Jacobson's (1968) original study. The current research is interested in the Golem effects whereby a teacher may assign lower expectations to a dyslexic individual and these may become self-fulfilling.

Brophy (1983) proposed a six-stage model of how expectations may become self-fulfilling. Firstly, teachers form differential expectations of their students, in this case, this may be based on their understanding that the child is dyslexic. Secondly, teachers treat students according to their expectations. This then results in the third stage in which students become aware that the treatment they are receiving is different to the treatment

towards other students in the classroom. Thus, at the fourth stage of the process student's self-belief about their ability will be altered to match the teacher's. This will then, in turn, compliment and reinforce the teacher's expectations about the child. Finally, the student's achievement will be altered in line with the expectation, indicating that a self-fulfilling prophecy has occurred.

However, while this may make sense at a theoretical level, it is very difficult to prove that this effect is taking place. Firstly, as suggested by Jussim and Harber (2005), it is possible that the teacher's expectation of the child is an accurate expectation, therefore, it is difficult to determine how much of the behaviour is an accurate reflection of the student's ability, and how much is a result of teacher expectation. Secondly, as alluded to in the ecological systems model, while teacher-child interactions may form a 'proximal process' between the microsystem and the individual, there are also many other interactions that may be influencing the child's outcomes, outside of their teacher's belief. Therefore, it is necessary to turn to research that has attempted to isolate the teacher expectancy effect from other potential correlates of academic achievement.

Zhu, Urhahne and Rubie-Davies (2017) investigated the teacher expectancy effect in teachers of 294 fifth-grade students in China. In order to isolate the effect of an accurate predication of the child's ability, they controlled for both the child's prior achievement, and their motivation to achieve in the future. They found that teacher judgement was longitudinally related to future achievement. In particular, they distinguished between the 'Golem' and 'Galata' effects and found that negative expectations were more strongly related to student academic outcomes. They conclude that their results should

> remind teachers to take care of how they judge and behave towards students [as] young learners are sensitive to teacher signals such as that the effects on students' academic outcomes can be detected even longitudinally (Zhu, Urhahne & Rubie-Davies, 2017).

This, therefore, provides evidence of a teacher expectancy effect even when controlling for other influential factors. Furthermore, Friedrich et al. (2014) conducted a longitudinal study of 1,289 fifth-grade students in Germany.

The study found effects of teachers' expectancy was positively related to students' tests scores at the end of the school year even while controlling for sex, age, figural reasoning ability, and prior achievement. Thus, it appears that they may be some accuracy in a theory that suggests that a teacher's expectations may in some way shape their student's outcomes.

Further research has attempted to explore what mediates this relationship. One key finding is the impact of student's self-concept. As discussed in Section 3.1 research has shown that students with dyslexia show a lower self-concept. Therefore, it is interesting to explore how this may be related to teacher expectancy. Previous research has shown that self-concept can be positively influenced by both prior academic achievement and by the ability judgement of significant others, in-particular, teachers (Marsh, Craven & Debus, 1998; Spinath & Spinath, 2005). As it could be expected that those with dyslexia may have more negative prior academic experiences, it is important to consider role of the teacher. Urhahne et al. (2011) looked specifically at teachers who underestimated students' performance. They found detrimental effects on students' academic self-concept, their own expectancy to succeed, and their anxiety levels. They conclude that "teachers should be informed about these judgement biases and be aware of possible effects of their judgements on students' self-perception" (Urhahne et al., 2011, p.173). In an attempt to counteract the effects of negative teacher expectancy, Rubie-Davies, Peterson, Sibley and Rosenthal (2015) conducted an intervention study in which they delivered workshops that were designed to make teachers aware of potential expectancy effects and train them to act in ways that showed higher expectancy towards their students. They found that students in the classes of teachers that had received this training gained higher grades in a maths test after a year, in comparison to a control group whose teachers had not completed the training. Therefore, highlighting how teachers' expectancy behaviours can influence outcomes.

As is suggested by Urhahne et al. (2011) the effect on self-concept is stronger when the teacher has negative expectations for their students, compared to positive expectations. Madon, Jussim and Eccles (1997) also found that the self-fulfilling prophecy effect was larger in low achievers. It is interesting to speculate how membership of a group, in which negative

expectations are attributed, impacts the teacher expectancy effect. This leads to the question of how being categorised as dyslexic may impact this process.

Hornstra et al. (2010) examined both teachers' explicit attitudes towards dyslexia (using self-report measures) and implicit attitudes (using an implicit attitude test). They found that the teachers' implicit attitudes towards dyslexia positively correlated with how the teacher rated the students' achievement on writing and spelling tests. However, the teachers' explicit attitudes were not related to these measures. The study showed that while the teacher outwardly spoke about dyslexia in a positive light, they held different implicit attitudes. Therefore, although teachers may not actively speak of a negative effect of dyslexia, they may hold negative internal ideas about how it may affect students. These implicit attitudes may be picked up on by the child and cause a self-fulfilling effect. However, what remains to be explored is how these negative connotations of dyslexia are formed; it is thus important to question what teachers believe dyslexia to be. Should teachers' expectations of dyslexic students be negative, this may influence the teacher expectancy effect and may cause negative effects on both the child's self-concept, and potentially their academic outcomes.

Babad (2009) states that "many teachers expectations are based on commonly held stereotypes derived from available information and generalisations about distinct groups of students" (p.79). Bearing this in mind, it is therefore important to question the stereotype of dyslexia and how this may influence teachers' interaction with dyslexic students. Therefore, when investigating the macrosystem it is important to explore the concept of stereotypes and what 'stereotypical dyslexia' may look like in order to understand how teachers' opinions of dyslexia are formed. This will be explored further in section 3.5.1 in the 'macrosystem' discussion of this chapter.

3.3.4 Teacher knowledge

In order to understand what teachers may expect from a dyslexic student, it is necessary to question their understanding of dyslexia. To examine training teachers' understanding of dyslexia, Mortimore (2013) surveyed 35 education students at a university in England, with participants being asked to provide their own definition of dyslexia. All the definitions that participants provided focussed on the difficulties associated with dyslexia and no strengths associated with dyslexia were mentioned. Additionally, 74.3% of the definitions described the behavioural issues of writing and spelling, while 48.6% described reading difficulties. A larger sample of students (n=247) were asked to select the traits most commonly linked with dyslexia. Over 90% of participants endorsed traits of literacy difficulties, indicating a strong preference for students to attribute their understandings of dyslexia as behavioural.

A further study conducted by Bell, McPhillips, and Doveston (2011) compared how teachers in the UK and Ireland conceptualise dyslexia using Frith's (1995) causal model to map their data. They found that the majority of mainstream teachers used behavioural definitions when asked 'how do you define dyslexia?' More than half of the teachers in the UK did not mention the underlying behavioural and cognitive difficulties associated with dyslexia. When the mainstream teachers were probed further about particular areas of difficulty results indicated that the teachers did not prioritise the 'phonological awareness deficit' and were more likely to mention memory difficulties. This is concerning as, as mentioned in Section 2.3.2, a large body of research into the underlying causes of dyslexia contends that phonological awareness is a prerequisite to reading difficulties and that interventions at this level are the most effective. Consequently, despite the much earlier body of work put forward by Frith (1995), which suggested that acknowledgement of all three levels is necessary for a good understanding of dyslexia, it would appear that there is a strong tendency to attribute dyslexia to the singular behavioural level.

However, some studies have reported a more holistic understanding of dyslexia in the teaching profession. For example, Regan and Woods (2000) conducted focus groups with 36 teachers and learning support

assistants in the UK and asked them to provide a definition of dyslexia. The focus group participants touched upon all the levels recognised by Frith (1995) by providing biological and cognitive definitions to explain behavioural symptoms. However, the researchers noted that understanding between individuals was varied. Due to the small number of participants in this study it is important to further investigate whether teachers define dyslexia across all three levels, when they are asked individually to provide a definition of dyslexia.

Moreover, Washburn, Binks-Cantrell and Joshi (2014) surveyed 171 pre-service teachers in the USA and the UK to investigate whether they held misconceptions about dyslexia. They found that teachers in both countries reported several misconceptions about dyslexia. Most notably a majority of pre-service teachers surveyed stated that dyslexia is caused by issues with visual perception. As previously discussed in Section 2.3.2 research that has explored the connection between visual stress and dyslexia has been inconclusive, Washburn, Binks-Cantrell and Joshi (2014) stated that the teachers surveyed were misinformed about visual stress being directly related to dyslexia and concluded that pre-service teachers need to be taught up-to-date, evidence-based information about the nature of dyslexia.

Washburn, Binks-Cantrell and Joshi's (2014) study built on earlier research by Wadlington and Wadlington (2005) who conducted a study of 250 faculty members and students in a college of education in the USA and also found that misconceptions were held about visual issues and dyslexia. Both surveys asked teachers to use a Likert scale to indicate whether they thought a statement about dyslexic people struggling with visual issues was true or false. As the teachers in these studies were prompted to consider the visual aspects of dyslexia, it is of interest to explore whether teachers mention visual issues when they have not been promoted to do so.

Conclusions from these studies suggest that teachers' knowledge of dyslexia is not consistent and is mainly based on behavioural definitions. Therefore, suggesting that the stereotypical idea that teachers hold of dyslexia is that it concerns surface level issues such as struggling with literacy. Furthermore, teachers appear to hold misconceptions about dyslexia. As stated by Babad (1998), teachers' expectations are based on commonly held stereotypes, suggesting that teachers may expect those with

the label of dyslexia to be struggling with literacy. However, a relatively small number of participants were used in these studies, and, while they investigated how the teachers define and understand dyslexia they did not investigate what impacts teachers' understanding.

3.3.5 The impact of teachers' understanding

As previously identified, those diagnosed with dyslexia and other SENs, often have a lower academic self-concept. Previously discussed was how teachers may influence their students' outcomes, however, these effect sizes have often been found to be small (Jussim & Harber, 2005). Yet, if we understand this within the complex system (as demonstrated by figure 3.2), then it could be suggested that teachers are simply one of the many aspects that could interact to be involved in this system. Therefore, how the teacher views dyslexia may also impact the students' attitude towards their learning. Teachers understanding about what dyslexia is, is also complex, yet, "changes in beliefs lead to changes in practice that bring changes in student learning that bring further changes in practice that result in additional changes in belief and so on" (Opfer & Pedder, 2011, p.395). Therefore, in investigating this system it is important to establish what teachers believe dyslexia to be which may in turn influence the processes within this system. Robertson and Patterson (2006) state that:

> Non-linear parts of the system interact in nonlinear ways […] interactions between and among students and teachers are interdependent; each response influences ongoing interactions. It is futile to look for one "root cause" of an action because the influences are many and massively entangled (p.2).

This, would suggest that it is futile to, for example, look specifically at teacher expectancy effect. Given that education systems involve "living things, language, cultural and social systems" (Cilliers, 2005, p.41) it is of no surprise that the effect of teacher expectancy is small as it interacts with many other aspects within the system. However, this does not mean that it is not important to look at what teachers understand about dyslexia in order to help to understand the complex system as to why students with dyslexia may have a lower academic self-concept.

3.4 Exosystem

Within the ecological systems theory, the exosystem includes settings in which an individual is not directly involved, yet they have influence over the individual's development. Teachers have been found to have a significant influence on the experiences of dyslexic individuals. This leads us to question how teachers may be influenced by policy suggestions. Decisions on policy around dyslexia can be described as distal processes. Distal processes can influence the proximal processes between the child and actors in the microsystem (e.g. child and teacher interactions) which in turn impact the child's development.

3.4.1 Current relevant policy

Identifying children*:* Currently children with dyslexia in England are likely to be categorised as having special educational need and disability (SEND). A child with SEND is defined in the Children and Families Act 2014 as:

> A child of compulsory school age or a young person has a learning difficulty or disability if he or she—
>
> (a) has a significantly greater difficulty in learning than the majority of others of the same age, or
>
> (b) has a disability which prevents or hinders him or her from making use of facilities of a kind generally provided for others of the same age in mainstream schools or mainstream post-16 institutions. (p.19)

Wales uses similar criteria based on the definition provided in the Education Act (1994) and classes dyslexia as an Additional Learning Need (ALN).

It is easy to see how dyslexia fits into this inclusive category of SEND or ALN. However, there is no doubt that children with many differing issues will also fit into this category. Within this approach to learning difficulties dyslexia is seen as part of a "continuum of special needs" (Riddick, 2001, p.223). Therefore, an individual does not need a specific diagnosis of dyslexia to be identified as SEND or ALN and receive the extra help that comes with this. However, in a survey of parents with children with dyslexia 55% said that their child's teacher failed to notice a problem with their child's development (Dyslexia Action, 2012) suggesting that a diagnosis of dyslexia may be helpful in order to access support.

Teacher requirements. The current policy guidelines in Wales state that when referring a child for SEN intervention (School Action) the following procedure should be followed:

> A school's system for observing and assessing the progress of individual children should provide information about areas where a child is not progressing satisfactorily even though **the teaching style has been differentiated**. These **observations** should be enhanced by **knowledge built up over time** of an individual child's strengths and weaknesses. Using this evidence, **class teachers may come to feel** that the strategies they are currently using with the child are not resulting in the child learning as effectively as possible. Under these circumstances, **they will need to consult** the Special Educational Needs Coordinator (SENCo) to consider what else might be done. The starting point will always be a review of the **strategies currently being used** and the way in which these might be developed. The review may lead to the conclusion that the pupil requires help over and above that which is normally available within the particular class or subject. Consideration should then be given to helping the pupil through School Action [my emphasis] (DfES 2001, p.50).

The highlighted sections show that the class teacher has a key role in identifying an individual who may have a SEN. Furthermore, they need to have the necessary knowledge about SEN to differentiate their teaching style accordingly and be able to asses that the child is not progressing as a result of this. Therefore, while it is not a teacher's job to diagnose dyslexia, it is important that they have an accurate understanding of the underlying behavioural and cognitive difficulties associated with dyslexia so as to identify those that could be at risk and to intervene appropriately.

Furthermore, the Rose Review (2009) calls for educators to "closely observe and assess [children's] responses to pre- and early reading activities in comparison to their typically developing peers" (Rose, 2009, p.11). If teachers do not have a thorough, working understanding of dyslexia, these differences may go unnoticed.

Suggested adjustments for dyslexic pupils: There is a strong body of evidence that shows that effective interventions can help to alleviate the difficulties often found in those with dyslexia. As explored in Section 2.3.2, interventions that target phonological processing skills have been found to be effective (Duff & Clarke, 2011; Fletcher et al., 2006; Savage & Carless,

2008; Rose, 2009; Snowling and Hulme, 2011). Consequently, as intervening at this level can improve a pupil's literacy performance, it could be argued that teachers need to be trained to understand how to recognise a child who is struggling with these cognitive skills and how to intervene to improve performance. Furthermore, Snowling (2013) states that "a good starting point for developing an intervention is understanding the causes of a disorder" (p.12). Therefore, it is vital that teachers have a good understanding of both the causes of dyslexia and the evidence-based interventions that have been proven to benefit those with dyslexia. With this knowledge teachers will be able to help their students effectively.

In addition to the recognition of dyslexia allowing appropriate interventions to be implemented, recognition of dyslexia also opens up resources for the dyslexic pupil. For example, if proof can be given that the pupil will be "at a substantial disadvantage in comparison with a pupil who is not disabled" (JCQ, 2017, p.3) reasonable adjustments will be made when the pupil sits examinations. In the guidelines provided by the UK's Joint Council for Qualifications (JCQ) adjustments for those with "General and/or Specific Learning Difficulties (such as Dyscalculia and Dyslexia)" (JCQ, 2017, p. 15) can include:

> supervised rest breaks; extra time; a computer reader or a reader; read aloud or an examination reading pen; a word processor; a scribe; a prompter; a practical assistant; coloured overlays; coloured/enlarged papers; modified language papers. (adapted from, JCQ, 2017, p. 15).

Access to these adjustments can offer real benefits to anyone who qualifies for them. In order to qualify for these adjustments, evidence needs to be given of tests in which the pupil has shown below average ability. For example, to qualify for 25% extra time, the JCQ requires a report from the school SENCo in which the pupil has at least one standardized test score that is 84 or less; two tests that are between 85 and 89; or, three or more scores that are between 90-94. In order to provide this evidence, the school SENCo must have confirmation of these scores. The JCQ (2017) state that those with the higher standardized scores are less likely to be granted extra time, however evidence of "a diagnostic report […] confirming a significant learning difficulty of disability […] undertaken by a [Health and Care

Professions Council] HCPC registered psychologist or specialist diagnostic assessor" (p.25) will increase their likelihood of being awarded extra time. Therefore, it can be argued that an official diagnosis is beneficial in the case for being granted extra time. Yet, the aforementioned definition of a SEND/ALN implies that official diagnosis is not needed in order to fall within this category. However, without this, it is unclear how the SENCo will gain access to these scores. Furthermore, they will not have a diagnostic report if the pupil is a borderline case. Therefore, highlighting the benefits of official diagnosis for access to examination allowances.

Obtaining diagnosis: Although dyslexia is recognised under the UK Equality Act, diagnosis is not funded by the National Health Service (NHS). Therefore, in England and in Wales the child is either referred to the local educational authority (LEA) for assessment or is privately assessed. According to the British Dyslexia Association (BDA) the cost of assessment from an individual registered with the HCPC is "is £450 (+ VAT) with a specialist teacher and £600 (+ VAT) with an Educational Psychologist" (BDA, n.d) (prices true of September 2018). Thus, it is clear that the cost of diagnosis, may isolate some people from gaining access to the test. Therefore, it could be hypothesized that, due to these exosystem factors, either the child is struggling significantly and is therefore, recognized by the class teacher and/or SENCo and is referred to the LEA for assessment, or, the child's parents are able to seek and pay for a private diagnosis.

Teacher training: A further exosystem actor that may indirectly influence the dyslexic individual is the teacher training experiences of the child's teacher. The National Teaching Standards framework in England states that teachers must "have a clear understanding of the needs of all pupils, including those with special educational needs […] and be able to use and evaluate distinctive teaching approaches to engage and support them" (Department for Education, 2011, p.12). Furthermore, the Professional Standards for Teaching and Leadership in Wales state that at Qualified Teacher Status (QTS) level the teacher should "demonstrate knowledge, understanding and experience of high expectations and effective practice in meeting the needs of all learners, whatever their different needs"

(Department for Education and Skills, 2017, p. 25). This suggests that every teacher should have the skillset to address individual pupil's needs and respond to these appropriately. However, inadequate teacher training may leave teachers ill-equipped to meet this requirement.

Research conducted in 1996 suggested that despite the increasing contact that teachers had with pupils with SEN at the time, it was not adequately covered in initial teacher education (ITE) (Garner, 1996). With continuous research into SEN and dyslexia, it would be expected that this situation has improved. However, Webster and Blatchford (2015) conducted qualitative interviews with teachers and teaching assistants and found that over a third of all participants said that they had not received the training they needed to support the students with SEN in their classes. This could be explained by evidence given by the BDA for the Carter Review of ITE which depicted a "lack of coverage in ITE on dyslexia" (Department for Education, 2015, p.58). A similar independent report on ITE in Wales states that SEN is "difficult to tackle in sufficient breadth and depth in ITE alone" (Department for Education and Skills, 2013, p.24). Both reports suggest the use of continued professional development (CPD) following ITE for teachers to gain a better knowledge of the subject. However, Webster and Blatchford's (2015) results suggest that this may not be happening.

Summary of Current Policy and Practice. From looking at the policy suggestions that are in place around dyslexia, it appears that there may be room for improvement. While a diagnosis of dyslexia is not needed for 'School Action' intervention, it is often needed for a child to access adjustments in examinations. Furthermore, while teachers are expected to identify and intervene with those that show dyslexic symptoms, it has been reported that teacher training on the area is poor. Research by Parsons and Platt (2017) found that, despite controlling for child, family and environmental characteristics, children with SEN in England made less progress than peers with a similar ability between ages 7 and 11. They therefore, argue that more needs to be done in supporting the educational development of children with SEN. This suggests that the current SEN policies in place are failing to meet these children's needs. However, while this suggests issues with the SEN system as a whole, this research did not

break down to look at individual SENs, therefore, it is unclear whether the system is unbeneficial to dyslexic children specifically.

3.5 Macrosystem

According to the ecological systems model, the macrosystem is the furthest system from the individual and defines the cultural values of the society. Therefore, in exploring the macrosystem around a dyslexic individual, it is necessary to question how dyslexia is culturally understood.

3.5.1 Stereotypes

As previously explored, Babad (2009) theorised that teachers' expectations are often based upon commonly held stereotypes. Much academic research and debate has taken place around the subject of stereotypes. Allport (1954) stated "whether favourable or unfavourable, a stereotype is an exaggerated belief associated with a category. Its function is to justify our conduct in relation to that category" (p.191). Discussion on stereotypes has broadly fallen into two camps, that of cognitive and social psychology. Cognitive psychology views stereotypes as "the cognitive activity of treating individual elements in terms of higher-level categorical properties" (Augoustinos & Walker, 1998, p.631). From this perspective stereotypes are shortcuts made by the brain to make sense of the world. In order to simplify the complex social world, the brain categorises people into groups and attributes stereotypical characteristics to the members of that group. From a cognitive perspective, an advantage of classifying people in this way is that it reduces the amount of processing the brain is required to do when it encounters a new person. However, it would be wrong to not also consider social factors when considering stereotypes. In their review of theories of stereotypes, Augoustinos and Walker (1998) state that "stereotypes and stereotyping are inherently social" (p.632).

Stereotypes can be seen as socially formed as the characteristics that are assigned to a social category are often held in common in a society. This is most famously demonstrated by Katz and Braly (1933) who found that white students in the USA held clear, negative racial stereotypes about other ethnic groups. Not only were stereotypical attitudes found, but it was also

found that the students had shared ideas about the characteristics of these different ethnicities, therefore, suggesting a social component to stereotyping. Jost and Banaji (1994) stated that

> stereotypes serve ideological functions, in particular […] they justify the exploitation of certain groups over others, and […] they explain the poverty or powerlessness of some groups and the success of others in ways that make these differences seem legitimate and even natural (p.10).

Thus, stereotypes can also be examined in order to explain and justify social hierarchies. As stereotypes can be seen to have such a powerful effect on social order, it is important to question how these shared representations of groups are formed. Augoustinos and Walker (1998) state that stereotypes are:

> Cognitive, affective and symbolic representations of social groups within society which are extensively shared, and which emerge and proliferate within the particular social and political milieu of a given historical moment (p.635).

Therefore, they apply social representation theory to describe how stereotypes are formed. Social representation theory refers to the meaning making process that takes place when giving meaning to a social object such as a stereotype. Meaning is created through a system of social negotiation and, therefore, due to the social processes involved, meaning is not fixed and defined. Consequently, interpretation of the social environment is required in order to examine the stereotype.

3.5.2 Social representation theory

Moscovici developed social representation theory during the mid-20th century. His ideas built upon the ideas of Durkheim (1898), who proposed the idea of 'collective representations' whereby individuals within a society hold the same meaning of what a phenomenon is. For example, a certain religious society holds the same understanding of what that religion means to them as a society. Collective representations would only change through transformation of the whole society. Moscovici (1961) built on this idea with his theory of social representations. He drew upon Durkheim's concept

that we hold shared understanding of social objects. However, he felt that mass media within modern societies means that it does not always make sense to refer to meanings as constant. Therefore, he questioned how social knowledge is transformed and understood differently by different groups in society. Moscovici (1963) defined the creation of this knowledge as 'social representations' whereby "social representation is defined as the elaborating of a social object by the community for the purpose of behaving and communicating" (p. 251). In other words, how scientific knowledge becomes socialised into everyday 'common sense' dependent on the community of the individual.

In his work in 1961 and 1976 Moscovici aimed to demonstrate how three distinct segments of French society responded differently to the challenge of psychometric ideas (reported in Voelklein & Howarth, 2005). He suggested that what is 'picked up' by the individual, depends on their individual social context. For example, Moscovici found that whereas communist milieu generated negative stereotypes of psychoanalysis through the use of propaganda, within the Catholic milieu whilst also resisting the advance of psychoanalysis, propagation was used in an attempt to limit acceptance and shape attitudes. On the other hand, the urban-liberal milieu communicated their ideas about psychoanalysis through diffusion and communication within the milieu meaning that there was little resistance to psychoanalysis within this group. The results of this analysis lent support to the idea that both the content and the process of communication within a certain milieu can shape the understanding of those within that group and may also act to further segment these groups in society.

Social representations give society 'pillars of reference' meaning that individuals within a society can communicate about a subject. The idea has been regularly applied to science. For example, the idea of 'climate change' is known to many and discussed regularly by the media. While scientists present facts about the subject, an individual's society and the mass media largely dictate the meaning that they give to climate change. Furthermore, the attitude that an individual has towards climate change depends largely on their social context (O'Neill & Nicholson-Cole, 2009; Wibeck, 2014; Zehr, 2000). The same concept can be applied to dyslexia.

While research may present 'facts' about dyslexia, other processes are in place which allow people to form an idea of what dyslexia is.

Bauer and Gaskell (1999) state that:

the circulation of knowledge from a core of experts […] into the wider mass public involves the transformation of abstract and conceptual ideas, into more accessible images, metaphors, concrete objects and habitual practices (p.165).

Therefore, while scientific research may produce large quantities of information about dyslexia at the biological and cognitive levels, how this is interpreted and taken on board by the public depends heavily on the way that they interpret and understand that information. For example, through anchoring performed within the given milieu, an individual may interpret their own experience and knowledge in order to give the concept of dyslexia meaning.

Geijer (2003) based her thesis around exploring the ideas of social representation of dyslexia in differing professional groups in Sweden (originally published in Swedish, reported in Gustavsson and Selander, 2012). She held group discussions with teachers and healthcare professionals in order to understand how the different societies understood dyslexia. Healthcare professionals described dyslexic pupils' problems using medical terms whereas teachers spoke about the surface difficulties that the dyslexic students showed but were keen to discuss dyslexia "as someone else's knowledge in a field where they themselves lacked competence" (Gustavsson & Selander, 2012, p. 24). Geijer found strong stability in the thinking of the different groups. This provides evidence of social representations as despite drawing upon the same phenomenon, the different groups spoke about dyslexia in different ways. The healthcare professionals' knowledge was anchored using their formal training on dyslexia, whereas the teachers' knowledge was anchored using experience of working with students with dyslexia. This demonstrates how social representations of the same concept can differ in the discourses of different professional groups.

Thus, social representation theory can be used to explain how understanding of dyslexia may be formed. Applying this to the ecological

systems model, allows comprehension of how aspects of different systems may interact to shape how a teacher understands dyslexia. For example, the discourse used to describe dyslexia in the media (exosystem), may influence the teacher's understanding (mesosystem), which may then influence how the teachers interacts with the child (mircosystem) and thus, affect the child's own academic self-concept (individual). Therefore, it is necessary to explore how dyslexia may be portrayed. One example of research looking into this was conducted by Collinson, Dunne and Woolhouse (2012). They looked at visual representations of dyslexia in university prospectuses and government guidance framework. Their research involved interpreting the messages conveyed in these images. Images of dyslexic students working independently appeared much less frequently than images with teachers in view. The researchers suggested that this implies that dyslexic students need help and assistance. In documents for adult learners with dyslexia the paternalistic theme continues with pictures of adults doing actives that could be considered child-like. People who view these images may naturally assume that dyslexic people need extra support as they have lower ability. Presentations such as this may begin to objectify dyslexia as a disability that causes a person to struggle. If this idea is then reinforced through other mediums the subject becomes objectified within a society and the label becomes immune from being questioned and challenged.

3.5.3 Social class

A key macrosystem aspect is the impact of social class. In his own work, Bronfenbrenner (1958) reviewed the parenting styles of middle and working-class parents. He stated that because middle class parents placed greater trust in expert advice, their parenting practices were more in line with advice whereas working-class parents took a longer time to shift their parenting practices to be in line with expert recommendations, thus highlighting how values within social classes can impact an individual's development.

Research has suggested a growing class polarisation in most economically advanced societies with widening gaps between the lower and middle classes (Blanden & Machin, 2007; Foster & Wolfson, 2010).

Education has a large role to play in these societal divisions. As Whitty (2001) points out "there are not many families in this country who are education rich but poor in other respects" (p. 293). The argument that education is key to social exclusion is supported in a breadth of research. Glennerster (2002) states that key to eliminating child poverty is "to raise the basic skills of those at the bottom" (p. 3). Thus, it is reasonable to argue that education and social class are intrinsically linked. This makes it interesting to question, how dyslexia, as an aspect of the current education system, may be impacted by class. While a paper on special education by the then Labour government in the UK noted the strong correlation between having SEN and being from a disadvantaged background (DfCSF, 2010), Tomlinson (2012) states that

> a relatively undocumented theme is that much of the expansion of special education categories and demands for funding and resources have, from the 1980s, come from middle class and articulate parents who [...] have seized on expanding ways of defending children in need of special education and support (p. 273-274).

The connection between SEN and the middle class has been particularly highlighted in the case of dyslexia. In particular, the press has picked up on dyslexia being a 'middle class disorder' (The Daily Mail, 26/02/2014; The Independent, 27/02/2014), this, coupled with the fact that it is often necessary for parents to pay for dyslexia diagnosis, means that it is interesting to explore the potential association between dyslexia and the middle class. Therefore, this section will speculate about the macro-level impact of social class on dyslexia, and in-particular, the impact of belonging to the middle class.

Reay, Crozier and James (2011) claim that "above all the distinguishing feature of the middle classes is a particular set of values, commitments and moral stances [...] such as ambition, sense of entitlement, educational excellence, confidence, competitiveness, hard work and deferred gratification" (p.12). These values suggest that great emphasis is placed on education in middle class children. Historically, the middle class have used the education system to reinforce the class structure; Lockwood (1995) states that the middle class "have always used their superior moral and material resources to full effect, above all by giving their children a

competitive edge in the main site of social selection, the educational system" (p.19). This suggests that the middle class have capitalised on their resources in order to ensure educational success for their children. While historically, this came as access to public and grammar schools in the late 19th and early 20th centuries (Tomlinson, 2005) it could be argued that the middle class are still able to use their access to resources, and their knowledge of the education system, to ensure optimum outcomes for their children. The 1988 Education Reform Act bought about the marketisation of education as it enhanced competition between schools. Ball, Bowe and Gewirtz (1995) argue that middle class parents are more able to use their resources to manipulate this market to their advantage and are more able to choose the best schools for their children. For example, some parents may choose where to buy a house, depending on locality to a school that has a good reputation, whereas other parents may not have this luxury of choice. Correspondingly Platt (2011) states that

> Part of the effect of social class background can […] be fed through educational achievement, not only through private schooling but through particular choices of secondary schooling and support for learning. Thus, education does not form a transparently egalitarian route to outcomes but is itself subject to the stratifications processes that mean it can be better exploited by those already more advantaged (p.43).

Therefore, an individual's outcomes in education can not only be shaped by their ability, but also by their social class background. As contemporary education policies promote parental choice, it could be argued that this encourages and legitimizes self-interest in the pursuit of advantage for their children. Brantlinger (2003) describes 'selfish' middle class parents who are determined to ensure that their children outperform their peers. Financially, in 2003, for the first time in history, parents were spending more money on text-books for their children than their children's school (Gordon et al., 2003). Therefore, alongside the ability to manipulate the market with regards to where a child goes to school, those with financial resources are also able to provide means to support learning when the child is in school. This demonstrates the potential educational advantage for those whose parents can afford educational resources.

Furthermore, Reay (2004) describes how middle class children were differently positioned within their local educational market in comparison to their working-class peers. Middle class children spoke of strategies that would be put in place to manipulate the market and to get into the school of their choice. For example, children spoke of listing different family members' addresses in order to fall into the catchment area of the 'good' school. In comparison, while the working-class children showed that they were motivated to do well in education, structural inequalities inhibited their ambitions. Reay (2004) states that "educational markets operate […] as processes of differentiating schools, concentrating problems […] and pathologizing working class pupils" (p.1,019).

In addition to parents' ability to manipulate the market for educational advantage, parental involvement in assisting the delivery of education is now seen as an expectation. Ball (2003) argues that recent educational policies emphasise parenting roles and aim to make the boundary between home and school increasingly porous. Given that the current dominant discourse is that education is a means of enhancing economic growth, the argument could be put forward that "parents' work in supporting their children's schooling should increasingly be viewed as an economic as well as an educational activity" (Reay, 2005, p.105). Therefore, parents' ability to support their children in education, both financially and otherwise, could be seen as an important factor in the child's educational and economic prospects. In an interview survey of working-class and middle class parents, Reay (2005) found that parents' involvement in schooling was largely class-based. She argued that the middle classes are able to utilise their economic and cultural resources to ensure that there is a continued reproduction of their children's educational advantaged. Thus, it is interesting to question how the diagnosis of dyslexia may contribute to the reproduction of class structures.

Gillborn (2015) researched the experiences of black middle class parents with children who had SEN. He found that within his participants it was usually the parent who identified the problem and sought assessment for the child. He stated that "this involves drawing on both their economic capital (the financially expensive specialist assessments) and their cultural and social capital (often using friendship and professional networks to help

negotiate the system" (Gillborn, 2015, p.280). This discussion of capital builds on the work of Bourdieu (1984). In brief, Bourdieu suggested that a key divide between the middle and working class was the volume and composition of habitus possessed by those in the different social classes. Bourdieu proposed that habitus was made up of the type and amount of capital that a person has. Capital can be made up from economic capital (financial resources), social capital (the individual's social network) and, cultural capital (the knowledge of the right cultural codes of how to behave in various social contexts). This habitus then affects how the individual interacts with the field (in this case education). Reay (2005) describes how middle class parents have cultural capital in a combination of "requisite skills and competencies, confidence in relation to the educational system, a previous history of being supported educationally in the home, educational knowledge and information about schooling" (Reay, 2005, p.111). Relating to dyslexia, findings from Gilborn's (2015) study, therefore, suggest that parents in the middle class are able to mobilise their economic resources in order to get the child a diagnosis, and furthermore, they are able to use their cultural capital in the form of social networks and knowledge of the field to get the most out of the education system for their children.

　　As previously discussed, having a dyslexia diagnosis can lead to adjustments in examinations. As qualifications "are designed and delivered to differentiate pupils and students" (Platt, 2011, p. 107) and middle class parents have been shown to be motivated in ensuring that their child exceeds in education (Ball, Bowe & Gewirtz,1995; Brantlinger, 2003; Reay, Crozier & James, 2011) it is easy to see why gaining adjustments in examinations may be important to middle class parents. In contrast, working class parents may not have access to the economic resources to pay for the assessment. Furthermore, they may not have access to the networks and educational history that firstly, may inform them about the potential benefits of the diagnosis, and secondly, may help them in accessing this diagnosis.

　　Patterns within society tend to show that the lower social class a person is in, the lower their educational outcomes (Bradbury, Corak, Waldfogel, & Washbrook, 2015; Dearden, Ferri, & Meghir, 2002; Sullivan, Ketende, & Joshi, 2013). Furthermore, children with a special education need (SEN) are more likely to come from a disadvantaged background

(Anders et al., 2011; Blackburn, Spencer, & Read, 2010; Croll, 2002; Parsons & Platt, 2013). Yet, within the wider SEN category, dyslexia was not found to be correlated with higher levels of disadvantage (Parsons & Platt, 2013). However, Parsons & Platt (2013) used measures of disadvantage such as lone parenthood, income poverty and worklessness. While this offers interesting insight into the impact of disadvantage on SEN labelling, it does not provide information on the impact of social class, in particular, the impact of being middle class on SEN identification. Therefore, further research needs to be conducted into whether dyslexia is being identified across social classes, or whether it is more clustered within particular social classes.

Along with social class it is also interesting to investigate other factors that may also be associated with social class. The media have picked up upon official exam data which has shown that "one in five students in independent schools received extra time to complete GCSE and A-level exams last year" (BBC News, 10/02/2017). This suggests a correlation between having dyslexia and being able to afford to go to a fee-paying school, pointing towards a particular correlation between dyslexia and parental income. Additionally, Parsons and Platt (2013) and Anders et al. (2011) show correlation between parents having lower educational levels and their child having a SEN, however this has been unexplored with dyslexia specifically.

It is of interest to understand how the norms and values of different social classes may impact whether or not a child is labelled with dyslexia and furthermore, how the current dyslexia system may be contributing to the class structures that we see in the current education system.

3.6 Individual

Bronfenbrenner (1979) stated that interactions are bi-directional. Therefore, the environment can both influence and be influenced by the individual. Therefore, alongside considering aspects in the environment which may influence the dyslexic system, it is also important to consider individual characteristics.

3.6.1 Sex

There is evidence to suggest that fewer girls have dyslexia than boys. It has been found that in most school systems girls tend to be better at reading (Chiu & McBride- Chan, 2006; Machin & Pekkarinen, 2008), whilst there is also evidence that more boys than girls have phonological awareness difficulties (Lundberg, Larsman, & Strid, 2012). Miles, Haslum and Wheeler (1998) present evidence that shows that more males have reading disabilities. Furthermore, the results of the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) shows sex differences in reading skills across countries, suggesting that sex differences in reading are not down to educational practices or language orthography (OECD, 2015), indicating that they are biological in nature. Further research has shown that sex differences in reading skill are more apparent at the lower end of the reading distribution (Arnett et al., 2017; Hawke et al, 2009; Stoet & Gaery, 2015). This suggests that biological sex may be involved in reading difficulties such as dyslexia.

However, in studies of those that have been referred for a dyslexia assessment, the male:female ratio ranges from 3:1 to 5:1, whereas, in epidemiological studies of dyslexia, a smaller disparity has been found (1.5:1 to 3.3:1) (Rutter et al, 2004; Shaywitz, Shaywitz, Fletcher & Escobar, 1990). This suggests an over-referral of males for dyslexia assessments compared to females. Shaywitz (1996) spoke of the 'myth' of male vulnerability to reading disability (p.98). Shaywitz suggests that the reason more boys than girls receive a diagnosis of dyslexia is that girls are less obtrusive and attention seeking. Therefore, boys are bought to the attention of teachers more easily causing a disproportionate referral of boys. This goes alongside the current suggested 'moral panic' that boys are currently falling behind in the current education system (Epstein, Elwood, Hey & Maw, 1998). Platt (2011) talks of "the dominance of male voices in the classroom" (p. 113) and boys' "attention-seeking in the classroom" (p.114) as contributors to the academic underachievement of boys overall. This dominance could arguably lead to boys being put forward for dyslexia testing more readily than girls. Therefore, it could be argued that these

characteristics may interplay with biological academic ability in leading to a dyslexia diagnosis.

This raises interesting questions about the biological differences found between boys and girls, and how this may interact with environmental norms with regards to displays of gender. What is unclear here is whether there are biological differences which explain why more girls than boys have been found to have dyslexia, or whether there are environmental aspects at play which influence the perception of difficulties in boys and girls differently. Arnett et al. (2017) suggests that the overrepresentation of males can be due to two factors "one invalid part explained by referral bias, and one potentially valid residual part found in epidemiological samples" (p.719). To follow this up they studied sex differences in a sample of 2,399, 7 to 24 year olds and found a small male:female disparity (1.15:1). They concluded that "the higher prevalence of males with reading difficulties can be explained by a combination of males' slower and more variable processing speed and worse inhibitory control, although these are partly offset by males' better verbal reasoning" (p.726). These findings suggest that there are valid sex differences between males and females, however, the extent of these differences is not as large as the referral rates suggest. Therefore, there appears to be a complex system in the referral and diagnosis of dyslexia. While there may be some evidence for a biological underpinning in the differences between males and females, this does not entirely explain the large discrepancy in referrals for diagnosis.

3.6.2 Age

It is also important to consider how a child's age impacts the dyslexic system. It is plausible to suggest that the aforementioned variables may interact with the child's age. For example, parents may not be motivated to get their child tested for dyslexia at a younger age, as there are no standardised examinations. However, as a child gets older, a diagnosis may be needed to get extra time on important exams. Furthermore, the impact of dyslexia may not be as apparent before the child starts sitting standardised tests at an older age. Therefore, it is also necessary to consider how age impacts the dyslexia system.

3.6.3 Age in year group

Another interesting aspect which has become a growing area of research in education is how a child's age within their year group impacts their outcomes. Crawford, Dearden and Greaves (2004) produced a report on the effect being born in the spring or summer and therefore being young in the academic year in England. They found "large differences in educational attainment between children born at the start and end of the academic year in England" (p.1). These differences decreased as the child got older, but they state that the gap remains significant throughout compulsory schooling. Key findings from this report were that:

> Relative to children born in September, children born in August are:
>
> • 6.4 percentage points less likely to achieve five GCSEs or equivalents at grades A*- C;
>
> • around 2 percentage points less likely to go to university at age 18 or 19,
>
> • around 2.3 percentage points less likely to attend a high-status Russell Group institution;
>
> • around 1 percentage point less likely to graduate with a degree. (Crawford, Dearden & Greaves, 2004, p.2).

Similar effects of age have been found internationally. In the USA, Oshima and Domaleski (2006) found that the gap in performance caused by birth date was larger than the gap caused by gender differences. In Norway, Strøm (2004) found that, in particular reference to reading, younger children in the year group were particularly disadvantaged.

Large scale longitudinal datasets are the best ways to follow these trends as they can assess the impact of the month of birth over an individual's life course. Research using the MCS found that older children in the year group were significantly more likely to be placed in the highest set, whereas those who were younger were more likely to be in the lowest set (Campbell, 2013).

Relationships have also been found between birthday and SEN. Crawford, Dearden and Greaves (2004) show that "relative to those born in September, those born in August are 5.4% more likely to be labelled as having mild special educational needs at age 11" (p.2). Furthermore, Zoega, Valdimarsdóttir and Hernández-Díaz (2012) researched the relationship

between attention deficit hyperactivity disorder (ADHD) and month of birth and found that children in the youngest third of class were 50% more likely than those in the oldest third to be prescribed stimulants between ages 7 and 14. They conclude that the effect of age should be considered in the diagnosis process of ADHD.

Another interesting finding from research in the area, looked at teachers' evaluation of SEN and found that teachers were more likely to identify SEN in those who were younger in the class (Anders et al., 2011). This

> suggests that teachers may be using class reference rather than individual reference when assessing SEN; in other words, they use the same frame of reference for the whole class, irrespective of the differences between the children that can be explained by a younger age (Anders et al., 2011, p. 436).

This may help us to understand why more children with a summer birthday are being diagnosed with an SEN. If the teacher (and/or parent) is comparing the child with the rest of the cohort in the year group, and not with those of the same age, they may notice the effect of age hindering their performance academically, and identify this as a result of SEN, and not simply because they are younger in the year group. This is another example of the complex system in which dyslexia is diagnosed. The child's age may interact with both the teachers' awareness of SEN, and their awareness of the effects of age in the year group, to alter the probability of the child being put forward for a diagnosis of dyslexia. Donfrancesco et al.'s (2010) research supports this suggestion. They found that those with a lower age of school entry in Italy were more likely to have dyslexia. Therefore, it is of interest to investigate whether this is also the case in children in England and Wales.

3.6.4 Ethnicity

Evidence from the USA shows large ethnic disproportionality in SEN labelling (Donovan & Cross, 2002; Eitle, 2002; Skiba et al. 2004) whereby those from minority ethnic groups are found as more likely to be labelled with a SEN. However, Strand and Lindsay (2009) conducted a study of SEN

and ethnicity in England using school census data and found that while being a member of a minority ethnicity was a predictor of SEN, gender and poverty were stronger predictors. They also found differences between SEN types and minority ethnic groups. While they did not look specifically at dyslexia, analysis of those with a specific learning difficulty (SpLD) showed that when controlling for gender and poverty, those from Mixed White and Asian, Indian, Pakistani, Bangladeshi, Other Asian, and Chinese ethnic groups were significantly less likely to have a SpLD than White students (Strand & Lindsay, 2009). In addition, Parsons and Platt (2013) found that white children in the Millennium Cohort Study were more likely to be considered dyslexic when controlling for indicators of deprivation. This, therefore, suggests an overrepresentation of white people being considered as dyslexic.

However, arguments against using ethnicity as a variable in research such as this have been made. Williams and Husk (2012) claim that ethnicity is a socially-constructed variable. Therefore, without a "nuanced approach that sees ethnicity as a complex interacting variable" (Williams & Husk, 2012, p.13) attempts to measure it may be unrepresentative of the variable of interest. Additionally, Burton, Nandi and Platt (2009) argue that ethnicity should be measured using a number of different measures rather than the 'census-like' manner that is commonly seen in survey research. Therefore, care needs to be taken in the use of this variable in social science research.

3.8 Is the label beneficial?

While research evidence has shown that there is a correlation between low self-concept and dyslexia, some research points to this being a result of the label and not due to academic performance (Polychroni et al., 2006; Riddick et al., 1999). Yet, interview data suggests that diagnosis is a positive experience for the individual. Ingesson (2007) calls for an early diagnosis of dyslexia, stating that it is a protective factor against the low self-esteem that his participants reported. Similar results were reported by Glazzard (2010) whose participants stated that self-esteem increased after diagnosis. Glazzard suggests that this is because the diagnosis gave the participants a way to explain their difficulties, and therefore they valued the diagnosis.

Leitão et al. (2017) also stated that participants reported feeling negative and frustrated prior to diagnosis, but after diagnosis reported feeling relief and acceptance. Riddick (2010) looks more specifically at the experience of labelling with dyslexia and states that while diagnosis may be beneficial to the individual, it is not beneficial at the public level as it highlights the individual as being different from others. Therefore, there appears to be contradictions in whether or not the label is beneficial. On the whole, during the interview studies explored it appears that when individuals report on their experience of diagnosis, they report the benefits of the diagnosis. However, in studies that compare a dyslexic and non-dyslexic group with matched academic performance in quasi-experiments, negative effects of the label are apparent. Consequently, it appears that it depends on the type of research method employed whether or not a positive effect of the diagnosis is found. However, the interview studies and the questionnaires that have looked at the relationship between labelling, dyslexia and self-concept used relatively small sample sizes. Therefore, it is difficult to generalise any findings to the wider population, particularly as contradictory results have been found. Furthermore, while larger scale research by Jordan and Dyer (2017), using the MCS found that cohort members with dyslexia, experienced behavioural difficulties when entering the education system, they did not examine the effect of the label, or the education system, on the child's academic self-concept. This leads us to question whether large scale data will show a positive (as suggested by interview studies) or negative (as suggested by quasi-experimental) effect of being labelled with dyslexia.

3.9 Summary of Chapter

Frith's (1995; 1999) causal model of dyslexia suggests that for a full understanding of dyslexia we need to consider how the environment interacts with an individual's biology, cognition and behaviour. However, Frith does not offer a framework from which to explore this. Bronfenbrenner's ecological systems theory also suggests that for a full understanding of development it is not possible to look at the individual alone. The theory suggests that to fully understand the individual, it is necessary to look at the proximal and distal processes between the

individual and actors within their mirco, meso, exo and marco systems. Thus, the theory can be used to examine the system around the individual and how this may influence the child's development. Yet, Bronfenbrenner's approach could be seen as too simplistic in its description of development. Complexity theory can show us how actors within a system (e.g. gender, social class, age in year) may interact leading to an individual being diagnosed with dyslexia, and how this may have a complex impact on the individual's academic outlook.

A combination of these theories leads to the development of a conceptual framework of the dyslexic system: 'A complex system in which interactions between an individual and actors within their environment may contribute to both the identification of dyslexia, and the experiences of the dyslexic individual'.

Reoccurring within the literature around dyslexia, is that those with dyslexia show a low academic self-concept, and often, low self-esteem and high levels of anxiety. While theories at the individual level would suggest that dyslexia may be causing these feelings within the child, looking at the dyslexic system implies that in order to understand this it would not make sense to look at the child alone, but also to consider their environment. Therefore, it is important to investigate how actors within the system may influence the child. Aspects such as teachers, siblings, policy, social class, gender, age and ethnicity have all been theorised to impact dyslexia. Therefore, it is important to take these into account in order to fully understand the dyslexia system.

Research Questions

The aim of the current thesis is to explore the dyslexia system looking in particular at the system that is involved in a diagnosis being received, and the complex impact of that diagnosis both on the individual, and those within their environment. This thesis thus aims to answer the following research questions:

1. *What individual level aspects influence the probability of the dyslexia label?*

As discussed in Section 3.6 the individual may both be influenced by their environment and influence their environment. Therefore, it is firstly of interest to question what characteristics the individual may hold that could impact the dyslexic system. As explored, gender, age, age in year-group, and ethnicity may influence whether an individual is labelled with dyslexia.

2. *What other aspects within the dyslexic individual's environment may also influence the probability of the dyslexia label?*

In addition to individual factors, it is also necessary to attempt to understand the environmental characteristics that may alter the dyslexic system. The framework suggests that it is important to consider the environment that the individual is situated within. Therefore, it is necessary to question the environmental factors that may play a part in dyslexia diagnosis. These may include aspects such as social class and sibling configuration, as discussed in Sections 3.3-3.5.

3. *How does the dyslexia label impact academic self-concept?*

Previous research has shown mixed findings on the impact of the dyslexia label on academic self-concept (as discussed in Section 3.1). Furthermore, a large majority of research in this area draws conclusions about the relationship between dyslexia and self-concept but fails to control for other factors that may be involved in this relationship. Therefore, this research aims to isolate the dyslexia label and examine its impact on academic self-concept.

4. How does the dyslexia label impact academic aspirations?

Rimkute et al. (2014) found that those with dyslexia had lower academic aspirations than those without dyslexia, however, once academic achievement had been controlled for, this relationship was no-longer significant. Therefore, it is of interest to explore whether the dyslexic label impacts aspirations when other factors that are also associated with dyslexia are taken into consideration.

5. How does the dyslexia label impact the aspirations of teachers and parents?

Furthermore, unexplored to date is how the aspirations of teachers and parents are influenced by the dyslexic label, when other factors are considered. As discussed in Section 3.3 individuals within a child's micro-system can have a large impact on the child's development. Therefore, it necessary to question how the label impacts these individuals' understanding of the dyslexic child, in order further understand the results of Research Question 4.

6. What do teachers understand about dyslexia?

A key aspect in dyslexic individuals' experiences of their dyslexia is their teachers (explored in Sections 3.3.1- 3.3.3). Theories such as teacher expectancy effect highlight the potential importance of the teacher in influencing the child's outcomes. Therefore, a component in shaping the experiences of a dyslexic individual could be how a teacher understands it. Thus, this research will also question how teachers understand dyslexia.

7. What impacts a teacher's understating of dyslexia?

Finally, it is also important to question exosystem factors that may influence a teacher's understanding of dyslexia. For example, the training that teachers have had around dyslexia, and the setting that the teacher is based in. Furthermore, individual teacher aspects, such as their experience, may also influence their understanding. This may all shape the child's development in the area of dyslexia.

The following methodology section will examine how these research questions were studied.

CHAPTER 4

Methodology

4 | Methodology

In order to gain some understanding of how to answer the research questions, it is firstly important to appreciate that the systems in which these events take place are complex. As discussed in Chapters 2 and 3, it is clear that there is no simple cause and effect relationship both between showing a particular biological, cognitive or behavioural attribute and being diagnosed with dyslexia, nor in whether the diagnosis has a positive or negative effect on the individual. Both of these systems are complex, thus any causes within the system are complex, multifaceted causes. While Bronfenbrenner's theory has been criticised for not being easy to study, as complexity theory stems from the natural sciences, more work has been done on how to study complex systems. Therefore, it is necessary to turn to complexity theory in an attempt to understand how to investigate these systems.

4.1 How can we study a complex system?

To study complexity is to investigate how "specific changes and interactions at the individual level create, maintain, change or destroy local systems" (Williams & Dyer, 2017, p.3). Therefore, in order to understand what is happening in a complex system it is important to understand how specific individual differences may influence the wider system. Yet, as discussed in Section 3.2.2, the networks within this system are highly complex, and therefore, it may not be possible to fully understand the system of interactions which may lead to a person getting a diagnosis of dyslexia, and may influence their outlook on academia. However, Robertson and Patterson (2016) suggest that "although we cannot have a complete knowledge of complex systems, use of this framework […] has the potential to provide researchers with more detailed knowledge of complex systems" (Robertson & Patterson, 2016, p.9). Therefore, studying a complex system is a case of 'inference as the best explanation': while we cannot know the exact underpinnings of this complex causal system, we can look for potential actors within the network which may converge to a 'tipping point'.

This will give us more information about the dyslexic system than simply looking for linear relationships within the system.

Byrne (1998) states that "complexity involves both quantitative measurement and the development of mathematically formalized accounts of a reality based on those measurements- twin essentials of any quantitative programme of scientific understanding" (p. 55). Therefore, the study of complexity is quantitative in its nature. However, although quantitative methods may be the most appropriate to study complexity, they do not come without limitations. Looking at a system involves attempting to say something about the whole, by looking at information about the parts. However, as is the nature of a complex system, the whole may contain many aspects which are inducible by looking at the parts. In studying complex systems is not a case of hypothesis testing in which key relationships between predetermined variables are examined. Rather, studying a complex system is "a reflexive process in which the theory serves as a basis for the organisation of the model but the data itself is also used to generate ideas in an exploratory way which are then taken back for further review" (Byrne, 1998, p.66). Therefore, while the previously discussed theory sets up possible relationships to explore in the data, the data may also offer new, undetermined relationships and interactions that may reveal more about the system which is currently undiscussed in theory alone.

Thus, it is too simplistic to look for relationships between variables and infer causality to them. Given the complexity of the social world, to show that elements interact and lead to an event occurring is unrealistic. On the concept of homelessness, Williams (2018) states that "what is probably going on is that there a number of overlapping and interacting mechanisms that evolve over time, but whether they can be captured by the proposition of an elegant mechanism framework is debatable" (p. 5). Therefore, while we may claim that there is a 'dyslexic system', operationalising and studying this system is far from straight forward. Consequently, in order to research these aspects of the social world some inference is needed. In order to account for this, Williams (2018) proposed that we can think of mechanisms (such as the dyslexic system) in two ways:

1. Ontological: the actually existing mechanism of 'nature' (in this case of society);
2. Epistemology: the mechanisms that we propose to account for these outcomes (p.6).

Thus, in social science research, our aim is to align these mechanisms as closely as possible. While the systems are complex, they are not totally random, therefore by looking for patterns we can attempt to understand mechanism 1 by looking for relative invariances in mechanism 2. In the case of this research, we can look at variables that increase the probability of having dyslexia and use this knowledge to inform our understanding of what dyslexia is. Blalock (1961) states that:

> Reality, or at least our perception of reality, admittedly consists of ongoing processes. No two events are ever exactly repeated, nor does any object or organism remain precisely the same from one moment to the next. And yet, if we are ever to understand the nature of the real world, we must act and think as though events are repeated as if objects do have properties that remain constant for some period of time, however short (p.7).

Therefore, while what is really happening in the dyslexic system (mechanism 1) may be increasingly complex, in order to understand it to the best of our ability we must use mechanism 2 to, at least in part, uncover the workings of the system.

4.1.1 Studying complex variables

While some aspects of the social world are complex, others are easier to measure, for example, sex at birth, age, and income, are variables in which a reality exists and therefore have a generally agreed means of measurement. On the other hand, some variables have been socially labelled and defined meaning that measurement may widely vary. A key example is social class; as discussed in Section 3.5.3 the relationship between dyslexia and social class is an interesting one to explore. However, social class is a construct or 'interactive kind' (Hacking, 2009); therefore, in order to measure it, it first needs to be socially defined. Furthermore, in social research it is unlikely that participants self-identify their social class, rather, they are sorted into their social class based on some characteristic or feature. The intricacies of

social class are reduced into researcher categorization, often ignoring the complexities of the social world.

Yet, as discussed above, in acknowledging that dyslexia is a complex system, it is plausible to suggest that any relationship between dyslexia and social class is also complex. Thus, like any complex system, it is not possible to draw causal conclusions between social class and dyslexia, rather, we can look for patterns in this relationship and question what this tells us about both dyslexia and social class. Therefore, when looking at social class we have to work with the data that we have and, again, use the concept of 'inference as the best explanation'. While we may not be able to find a 'true measure' of social class, a significant corpus of work has been conducted into the most likely correlate of social class that can be measured. There are many different methods that have been used to measure social class. Platt (2016) states that these scales, most of which use occupational status as a starting point, "tend to provide largely consistent accounts of class structures" (p. 68). The present research will investigate social class using the NS-SeC scale. This is based on the same principles as the CASMIN scale, which was developed by assigning occupations to categories based on their "expected occupational rewards […] and the nature of the employment relations and the levels of control or oversight" (Platt, 2016, p. 70). The NS-SeC scale, used in the current survey, is also used by the UK Office of National Statistics to measure socioeconomic class. Therefore, while we are not measuring mechanism 1 (social class) in its true form, we are using a proxy in an attempt to align mechanism 2 (occupational status) with mechanism 1 (social class).

To study a system, a sample is drawn from the population and the sample is used to statistically describe the population with significance testing applied to understand the sample's version of the phenomenon. Error terms are used as "calculable tolerances" (Williams & Dyer, 2017, p.3), in which the larger the sample, the smaller the error terms become. Therefore, in applying the rule of large numbers, it is assumed that the larger the sample, the more likely that they will represent the target population. However, from the sample, we cannot necessarily infer the 'average' results of the sample to an individual unit within the population. Due to many individual differences within the social world, it would not make sense to

look at the sample, or even subcategories within a sample, as a homogenous group. However, complexity methods allow researchers to look for groups that may share common patterns and characteristics which give rise to similar outcomes. Thus, allowing investigation of how membership of a particular category can lead to an increase or decrease in probability of an expected outcome.

4.1.2 Experimental methods vs. the social survey

Two key quantitative methods could feasibly be applied to study the phenomenon of interest in this thesis. Firstly, experimental methods could be applied. To look at the impact of the dyslexia label this would involve diagnosing one sample with dyslexia, while not diagnosing another sample, to view the impact of this diagnosis. Ignoring the obvious ethical implications of this research design, is has been argued that experimentalism would only work if the world was linear and cause is simple and single (Byrne, 1998). However, this is not the case. As previously explored, the underlying cause of dyslexia is complex and unclear, meaning that the impact on the individual is varied. Furthermore, as suggested by Bronfenbrenner's model, in order to understand the individual, it is necessary to examine the environment that they are situated within. Therefore, manipulating the individual, and studying the impact on the individual, would be to ignore the complex system that they are in. Therefore, it would not be possible to conclude that giving a person the dyslexia label, or not, would linearly cause differences between the two samples. There are many other actors that may be involved in this relationship.

An alternative to this experimental method is social surveys. Marsh (1982) argues that social surveys are a preferable method as they do not deal with abstractions from reality, as implied in experimental research, but rather they look at reality for what it actually is. In social surveys "data is constructed as numbers from real knowledge of the world held by respondents as information in the natural language of everyday life, then the non-positivist character can be seen for what it is" (Byrne, 1998, p.66). Therefore, rather than attempting to looking for unrealistic cause and effect

relationships, social surveys can allow some understanding of the complex social world.

It is also necessary to take into account time while investigating social phenomenon:

> Where individuals are surveyed at successive time points, then it is possible to investigate how individual outcomes or responses are related to the earlier circumstances of the same individuals. This provides the framework for very powerful analyses of the processes experienced by individuals; it enables a model to be constructed which explicitly takes into account the earlier circumstances suspected to have an effect which carries through into later life (Dale & Davies, 1994, p.2).

Therefore, the optimum way to examine a phenomenon is through longitudinal social surveys. Byrne (1998) discusses the importance of hierarchical structure in datasets for looking at complexity: "the important thing is that our data structures are hierarchical because they reflect the way in which the world is composed of a set of nested far from equilibric systems" (Byrne, 1998, p.125). Furthermore, Skinner (1997) states that "complex features of datasets, such as longitudinal or multi-level structures may be of intrinsic interest". Therefore, this research will use the Millennium Cohort Study (MCS), a large-scale, longitudinal research project, to investigate the aspects involved within the dyslexic system. However, no such datasets exist that investigates teachers' understandings of dyslexia. Therefore, to further investigate teachers' understandings of dyslexia a large-scale, cross-sectional survey of teachers will be collected. Therefore, this research will take a two study approach: The first looking at a large-scale longitudinal dataset for patterns within dyslexia; the second, a primary survey conducted to look at teachers' understandings of dyslexia.

4.2 Positionality

It is also important to briefly state how the research methods employed also allowed a more objective analysis of the research questions. As a dyslexic individual, naturally I have my own 'insider' opinions on the subject. However, using secondary data means that I could not influence the way that the survey was designed, or how the questions were asked. The teacher

survey was designed by myself, however, questions were designed to not lead the respondent in any way (discussed in Section 8.9). Written responses about understanding of dyslexia were coded using a method employed in previous research (Bell, McPhillips and Doveston, 2011) and were not coded as being 'right' or 'wrong' (discussed in Section 8.9.2). Furthermore, quantitative analysis of the data allows significant results to become apparent without the need for personal interpretation of the results.

4.3 Method justification

4.3.1 Bivariate analysis

In order to determine if there were significant relationships between the variables bivariate analysis was used. Bivariate analysis was used with the teacher survey data to investigate the relationships between teacher experiences and teacher understanding. This allowed initial understanding of the 'proximal processes' that may be taking place within the system. For example, should there be a significant relationship found between teachers' training experiences and teachers' understanding of dyslexia, this would suggest that there may be some interaction between the exosystem policy recommendations on teacher training, and the microsystem factors of teacher knowledge. Furthermore, bivariate analysis was also used with the MCS data to determine whether there were any initial relationships between dyslexia and actors within the system, such as socioeconomic class. However, while bivariate analysis was able to indicate that there may be a relationship between two variables, it could not tell us the direction of the relationship, or whether there may also be other variables involved in the relationship, therefore, logistic regression was also used.

4.3.2 Logistic regression

While regression analysis is the epitome of looking for a linear relationship, it is used in this thesis to look for patterns between actors that may interact within the dyslexic system. Therefore, while an original aim of regression analysis is to determine how much change in one variable contributes to change in the other, in this research, regression will be used for the

exploratory purposes of determining what actors may be at play in the dyslexia system.

Regression analysis allows exploration of how a predictor variable relates to the dependent variable, while taking the other variables into account. This is important as, while bivariate analysis may show that there is a significant relationship between two variables, there may be other variables that may be involved in this relationship. For example, while a significant relationship may be found between socioeconomic class and dyslexia, it could be hypothesised that what is driving this relationship is the child's parent's income, rather than being a particular social class. Logistic regression allowed all potential variables to be entered into a model so that these, often intricate relationships, can be untangled. Logistic regression was used both to explore the key predictors of teachers' understanding of dyslexia, and to determine the key predictors of dyslexia diagnosis.

4.3.3 Confirmatory factor analysis (CFA)

As discussed above, it is important to explore the relationship between ability and dyslexia. However, in the dataset used there was no single test of ability, rather cohort members were tested on a range of skills over the different data collection sweeps. Therefore, in order to generate a single ability variable CFA was used. CFA used data from observed variables to create a new latent variable. Various tests could then be applied to determine how well the new latent variable represented the data from the observed variables. Once the optimum solution was found scores were generated for each cohort member which represented their overall ability across the skills tested.

4.3.4 Propensity score matching (PSM)

Byrne (1998) suggests that the best way to study complex phenomenon is through the use of longitudinal data. However, while the current research makes use of a longitudinal dataset, the same group of individuals are not labelled as dyslexic throughout each data collection sweep (discussed in Section 5.1.7). Therefore, it is not possible to look at the effects of the label by comparing those that had the label at time 1(T1) and T2 with those who

did not have the label at T1 but who had it at T2. As the label cannot be isolated in this way, propensity score matching was used. This technique allowed the creation of the cohort members' likelihood of having dyslexia, based on specified criteria. The previous logistic regression analysis allowed the key predictor variables of dyslexia to be identified and these were then used to determine cohort members' likelihood or 'propensity' of having dyslexia. Generating the non-dyslexic cohort members' likelihood of having dyslexia, meant than they could then be matched with dyslexic cohort members with a similar likelihood of having dyslexia.

An alternative way of matching dyslexic and non-dyslexic cohort members would have been to select individuals who had the same frequency of characteristics that were associated with dyslexia, but did not have dyslexia. However, it is an "ecological fallacy to infer that the relationships involved at an aggregate level will hold at an individual level" (Williams, 2009, p.6). Therefore, just because a person holds the characteristics of those who have dyslexia, their probability of having dyslexia may be very different to the probability of the collective having dyslexia. PSM counteracts this problem by generating each non-dyslexic cohort member's probability of having dyslexia and matching with a dyslexic cohort member with the same probability. This takes into account the character of the social world; a few cases, however small, may have a low probability of having dyslexia, but still receive the label. Therefore, the matched group reflects these deviations.

The differences between these two groups was then examined. It could then be argued that the differences between the two groups may be down to having dyslexia or not, as opposed to other factors that may be associated with having dyslexia.

4.4 Summary of Chapter

Dyslexia can be viewed as a complex system; many variables may interact within the system that firstly may lead to an individual being diagnosed with dyslexia (e.g. gender, social class, month of birth), and secondly, may impact on the individuals academic outlook (e.g. teacher understanding). A common way to analyse this complexity is through the use of large-scale

surveys. The MCS and a survey of teachers will be used to investigate the research questions. Bivariate analysis, logistic regression, CFA and PSM will be employed to analyse the data.

Chapter 5

Millennium Cohort Study - Methods

5 | Millennium Cohort Study - Methods

5.1 Background

The Millennium Cohort Study (MCS) is a large-scale longitudinal study which aims to research a sample cohort of children born between 1 September 2000 and 31 August 2001 in England and Wales, and between 24 November 2000 and 11 January 2002 in Scotland and Northern Ireland. The survey covers a diverse range of topics. As is it longitudinal it allows progression and change over time to be studied; to date there have been six sweeps (Table 5.1)

Table 5.1 MCS sweeps

Sweep	Age (≈)	Number of families
MCS1	9 months	18,551
MCS2	3 years	15,590
MCS3	5 years	15,246
MCS4	7 years	13,857
MCS5	11 years	13,287
MCS6	14 years	11,726

The current research focused on outcomes from MCS4, MCS5 and MCS6; whilst, cognitive information was taken from MCS2 upwards.

5.1.1 Sample design

The MCS sample draws upon children born during the period outlined above, with a 16-month time period allowing for less intense data collection and for season-of-birth effects to be studied. Children were identified using Child Benefit records as all families in the UK received this state benefit at the time of the first sweep.

Children from deprived areas and high ethnic minority areas were oversampled so that the effects of these demographics could be analysed. In order for this to be possible the population was stratified using area-level measures. The population was spilt into three strata in England (advantaged; disadvantaged; ethnic) and two strata in Wales, Scotland and Northern Ireland (advantaged; disadvantaged). The sample was also clustered according to the characteristics of electoral wards. Clustering was used as it is more efficient and cheaper to draw a sample from specific areas rather than the whole of the UK; it also allows for neighbourhood characteristics to be explored.

After selecting the sample wards, children who would be turning nine months old during the 16-month window were identified, and all eligible families were contacted (n=24,180). Consent was obtained via an opt-out procedure. The productive sample at MCS1 was 18,552. 692 families joined the study at MCS2 who were living in the sample wards at the time of MCS1 but whose addresses were not on the Child Benefit records at the time.

5.1.2 Attrition

It is an expectation in longitudinal studies that some participants will drop out of the survey over time; Table 5.1 shows that the number of families decreases over time. The most common reason for people not taking part in a survey was refusal, followed by families who could no longer be traced. When the family was not-active for two sweeps in a row they were no longer contacted for the following sweep. 47.2% of families participated in all sweeps to date, whilst 22.1% of families missed one of the sweeps but then returned to the study. Attrition leads to smaller samples and therefore lowers statistical power. It can also cause biases in results as attrition is disproportionate to some groups (e.g. disadvantaged; young; long working hours). Consequently, over time, the sample will no longer represent the population that it was drawn from and will therefore be non-generalizable.

5.1.3 Weighting

In order to combat the effects of attrition, the MCS produces weights to adjust for those who have dropped out of the study. It also produces weights to take account of the oversampling of disadvantaged and ethnic groups which was present in the first wave. Table 5.2 shows the original number of families by stratum and country.

Table 5.2 MCS cases by stratum and country

	England		Wales		Scotland		N Ireland		UK	
Strata	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Advantaged	4,828	39.5	832	30.1	1,145	14	723	37.7	7,528	39.1
Disadvantaged	4,806	39.3	1,928	69.9	1,191	51	1,200	62.3	9,125	47.4
Ethnic Minorites	2,591	21.2	n/a	n/a	n/a	n/1	n/a	n/a	2,591	13.5
Total	**12,225**	**100**	**2,760**	**100**	**2,336**	**100**	**1,923**	**100**	**19,244**	**100**

(adapted from Hansen, 2014, p.16)

As there was a disproportionate number of disadvantaged and ethnic minority families sampled, as well as oversampling in Wales and Northern Ireland, the MCS initially included the weights shown in table 5.3. The MCS provided weights for both country level and UK level. As this study is investigating dyslexia in England and in Wales, the country specific weights are applied. This means that the results are representative of England and Wales, rather than the UK as a whole (see Appendix B for correspondence with the dataset creators for clarification of which weights should be applied).

Table 5.3 MCS weights

Strata	England	Wales
Advantaged	2.00	0.62
Disadvantaged	1.09	0.23
Ethnic	0.37	

(adapted from Hansen, 2014, p.16)

In addition to weights to account for oversampling, the MCS also provides weights which adjust for non-response; in MCS1 and MCS2, factors that correlated with non-response were used to produce non-response weights. For each sweep following "the longitudinal weight is the product of the longitudinal weight at the previous sweep multiplied by a non-response weight for the current sweep" (Hansen, 2014, p.17).

Where individual sweeps were investigated, the appropriate weight was applied for analysis. In analysis which involved factors across sweeps, the weight from MCS6 was applied as it considered more of the missing data.

5.1.4 Structure of data collection

For each sweep, an interviewer would visit the cohort member's home in order to conduct the interview. When the cohort member was younger, more questions were asked of the main carer. However, as the cohort member has got older, they have directly been asked more questions. At each sweep, there were three different versions of parent interviews that could be completed, these were: parent, partner and partner proxy. The person who answered the questions depended on the composition of the household. In most cases any parents of

cohort members and partners of parents were interviewed. If no parents were present, the main carer of the cohort member was interviewed. If the person selected for the partner interview was not present at the time of the interview, the main carer would complete the 'partner proxy' interview on behalf of their partner.

Questions have also been asked of the older sibling (age 3; age 5) and a written questionnaire has been sent to teachers (age 5; age 7; age 11). Table 5.4 shows what has been included in each survey to date.

Table 5.4 Contents of each MCS sweep

	MCS1 (9 mos)	**MCS2 (3 years)**	**MCS3 (5 years)**	**MCS4 (7 years)**	**MCS5 (11 years)**	**MCS6 (14 years)**
Parent Interview	X	X	X	X	X	X
Cognitive assessment		X	X	X	X	X
Physical measurement		X	X	X	X	X
Young person questionnaire				X	X	X
Older siblings			X	X		
Interviewer observations		X	X	X	X	X
Teacher survey			X	X	X	
Consent to data linkage	X	X	X	X	X	
Saliva samples		X				X
Time use record						X
Activity monitor				X		X

The current study focused on results from the parent, young person and teacher surveys at age 7, age 11 and age 14, and, results from cognitive assessments at all sweeps.

A mixture of self-completion surveys and face-to-face interviews were used to collect the information from the cohort members and parents. The interviewer followed a schedule using a computer-assisted personal interviewing programme (CAPI) which automatically routed the questions depending on the answers given.

5.1.5 Target population

This research chose to focus on the data from England and Wales only. This was for a number of reasons. Firstly, all four nations in the UK have different education systems, therefore, it would not make sense to look at the UK as a whole, without considering differences and similarities across countries. As discussed in section 3.4.1 England and Wales have different education systems; therefore, the research will investigate whether there are differences in the likelihood of having dyslexia according to whether or not the cohort member lives in England or in Wales.

Secondly, the research uses data from the teacher survey at age 11 which was only conducted in England and Wales, therefore, in order to compare groups across ages it would not have made sense to include the cohort members from Scotland and Northern Ireland.

Finally, the second study in this thesis focuses on teachers in England and in Wales, thus making the target population consistent across the thesis.

5.1.6 Data linkage

Individual pupil information for the cohort member has been linked, for those who consented, to the National Pupil Database (NPD) in England, and to similar data in Wales. In order to access this data, the researcher is required to gain access to the 'secure data service' via the UK Data Service. To gain access a course needs to be attended and a test passed. I achieved this accreditation and was able to access the English data via a secure computer. However, while the NPD provides information on special educational needs (SEN) it does not give information about the specific type of SEN. Therefore, questions in the dataset were used as proxies for this information. The teacher/parental report of dyslexia was used to establish whether the child had a label of dyslexia. Furthermore, as the NPD data was only available for the English cohort, an ability variable was constructed using confirmatory factor analysis (CFA) as an alternative measure of ability (explained in Section 5.1.8).

The NPD data was used to check the validity of proxy variables that were used in the study. For example, correlations and relationships between being labelled with dyslexia and being on the SEN register were examined (discussed in

Section 5.6.1). Strong relationships between proxy variables and variables from the NPD data showed a level of validity in the measures used.

5.1.7 Measures

I will now discuss the context of each variable that has been used in the current study.

Dyslexia

Whether or not the child had dyslexia was established by either the parent or teacher's report of dyslexia at each age. While previous research using the MCS has used administrative data on the NPD linked with the MCS in order to establish whether the child has an officially recognised SEN (Parsons & Platt, 2017), this dataset does not provide information on the type of SEN. Rather, the NPD dataset provides and overarching category of SEN, broken down into the type of support that the cohort member has received. As this research was interested in the dyslexia label in particular, it would not have been appropriate to use this more inclusive category. Furthermore, as this research was particularly interested in the impact of the dyslexia label, should the teacher or parent have referred to the child as dyslexic, then it could be assumed that the child was aware of this label, and the effects would be similar regardless of official diagnosis. Furthermore, Parsons and Platt (2013) used parent and teacher report of SEN in the MCS to investigate how it may be linked to disadvantage, whilst Parsons and Platt (2017) also use the parent and teacher reports of dyslexia, alongside the NPD data in identifying those with SEN.

However, due to this, we cannot assume that the children identified as dyslexic by their parent or teacher, have been officially diagnosed as dyslexic.

Dyslexia MCS4 (age 7). At age 7 both the main parent and the teacher of the child were asked if the child had dyslexia. In the parent interview the parent was asked *"What are the reasons for [child name]'s additional support needs?"* if they answered 'yes' to the question "*Has [child]'s school or the [local education authority/ education board] ever told you [he/she] has [special educational needs (SEN)/ additional support needs (ASN)]?*"). The parents were given a list of

possible needs from which they could select dyslexia. 121 parents in England and in Wales reported that their child had dyslexia (Table 5.5).

Teachers were asked to complete a postal questionnaire about the child. Teachers were asked to select dyslexia from a list of 'problems' under the question "*Do these specific problem(s) apply to this child?*" However, they were only required to answer this question if they responded 'yes' to the question "*Has this child ever been recognised as having Special Educational Needs?*" 95 teachers reported that their cohort member had dyslexia in England and in Wales (Table 5.5).

Table 5.5 Teacher and parent report of dyslexia at age 7

		Teacher report for dyslexia		
		Not Dyslexic	Dyslexic	Total
Parent report of dyslexia	Not Dyslexic	10,806	67	10,806
	Dyslexic	93	28	121
	Total	10,899	95	10,994

The results from the teacher and parent survey were combined to create a total of 188 dyslexic children at age 7.

Table 5.5 shows that only 28 teachers and parents agreed that the child had dyslexia, despite the parents being specifically asked if the school had told them that the child had a SEN. This raises questions about the validity of the sources along with interesting questions about why differences were found. However, the reasons for this remain unexplored to date, therefore, whether teachers or parents provide more reliable information about the child's SEN is unknown. Furthermore, as discussed above, the study is concerned with the whether the child has a label of dyslexia, and not about whether they are formally diagnosed with dyslexia. Therefore, results from both informants can be used. Additionally, previous research into this area has used both the teacher and parent reports of SEN in this age group (Parsons & Platt, 2013).

Dyslexia MCS5 (age 11). At age 11, only the teachers were asked to comment on whether the child had dyslexia. Of the children eligible for the teacher survey 77.3% of teachers were successfully surveyed. Therefore, 7,430 teacher surveys were completed. If the teacher responded 'yes' to *"Does this child have Special Educational Needs (SEN)?",* they were asked to select the reason from a list

which included dyslexia. The teachers at age 11 reported 253 children to have dyslexia.

Dyslexia MCS6 (age 14). At age 14 only the main parent was asked about whether or not the child had dyslexia. Firstly, the parent was asked "*Has [Cohort member's name]'s school or the [local education authority/ education board] | ever told you [he/she] has [special educational needs/ additional support needs]?"* If they responded yes to this question, the main parent was then asked the reason for the SEN. The parent could select dyslexia from a list. The parents reported a total of 291 children to have dyslexia at age 14.

Dyslexia Hybrid. As the same children were not consistently labelled as dyslexic over the three sweeps a 'dyslexic hybrid' group was made. This group contained any child who had been identified as dyslexic in any of the three sweeps. This assumed that, as they had been labelled with dyslexia at some stage, they associated with this label, even if it hadn't been picked up in a survey of teachers or parents in every sweep. 580 children were labelled as dyslexic at ages 7, 11 or 14, and, therefore, made up the 'dyslexic hybrid' group.

Summary of dyslexia variables. Table 5.6 shows the proportion of those with the dyslexic label at each sweep.

Table 5.6 Number and proportion of identified dyslexics

Age	**Dyslexic cohort members**	
	Weighted Number	Weighted Proportion
7	203	0.019
11	264	0.025
14	316	0.034

Table 5.7 shows the unweighted number of dyslexics identified in each sweep. This shows that the same children were not always identified as dyslexic in each sweep.

Table 5.7 Children identified as dyslexic in each sweep

		Age 8		Age 11	
		Not dyslexic	Dyslexic	Not dyslexic	Dyslexic
Age 11	Not dyslexic	14,766	151	-	-
	Dyslexic	216	37	-	-
Age 14	Not dyslexic	14,738	141	14,711	206
	Dyslexic	244	47	168	85

However, using the NPD data, it was possible to see how many of those identified as dyslexic in England, had also been officially identified with a SEN at age 11 on the NPD. Table 5.8 shows the number of cohort members identified as dyslexic in England at age 11, and those that are also identified on the SEN register. Of the 152 cohort members identified as dyslexic at age 11, 121 (79.6%) were officially identified as having a SEN on the KS2 NPD. This, therefore suggests a fairly accurate reporting of dyslexia as a SEN by teachers at age 11.

Table 5.8 Those labelled as dyslexic and on the SEN register at age 11, KS2

Age 11	No SEN (KS2)	SEN (KS2)	Total
Not dyslexic	5,791	1,535	7,326
Dyslexic	31	121	152
Total	5,822	1,656	7,478

Furthermore, of the 123 cohort members identified as dyslexic in England at age 7, 86 (69%) were also listed as having a SEN in the KS1 data (Table 5.9).

Table 5.9 Those labelled as dyslexic and on the SEN register at age 7 KS1

Age 7	No SEN (KS1)	SEN (KS1)	Total
Not dyslexic	5,920	1,420	7,326
Dyslexic	37	86	123
Total	5,957	1,516	7,473

Finally, of the 357 dyslexic cohort members in England at the dyslexic hybrid level 263 (73.7%) were on the SEN register at KS2 (Table 5.10).

Table 5.10 Those labelled as dyslexic and on the SEN register at any age KS2

Any Age	No SEN (KS2)	SEN (KS2)	Total
Not dyslexic	5,728	1,392	7,121
Dyslexic	94	263	357
Total	5,822	1,656	7,478

Therefore, while the reporting of dyslexia is not perfect, there does seem to be a significant overlap between the teacher or parent reporting dyslexia, and the child being on the SEN register in England. Thus, while we cannot conclude that all children identified as dyslexic by their parents or teachers had an official diagnosis of dyslexia, we can assume that a majority were registered as having a SEN and were receiving the support that comes with this.

Social class.

As discussed in section 4.1.1 social class is a complex variable. This study uses the NS-SeC scale in order to measure it. The scale classifies occupations as follows:

- 'Large employers'
- 'High managerial'
- (3.1) 'High professional trade'
- (3.2) 'High professional new'
- (3.3) 'High professional trade self-employed'
- (3.4) 'High professional new self-employed'
- (4.1) 'Low professional trade'
- (4.2) 'Low professional new'
- (4.3) 'Low professional trade self-employed'
- (4.4) 'Low professional new self-employed'
- (5.0) 'Lower managers'
- (6.0) 'High supervisory'
- (7.1) 'Intermediate clerical'
- (7.2) 'Intermediate service'
- (7.3) 'Intermediate technical'
- (7.4) 'Intermediate engineering'
- (8.1) 'Small employer industrial'
- (8.2) 'Small employer agricultural'

- (9.1) 'Self-employed non-professional'
- (9.2) 'Self-employed agricultural'
- (10.0) 'Lower supervisors'
- (11.1) 'Low tech craft'
- (11.2) 'Low technical operative'
- (12.1) 'Semi-routine sales'
- (12.2) 'Semi-routine service'
- (12.3) 'Semi-routine technical'
- (12.4) 'Semi-routine operative'
- (12.5) 'Semi-routine agricultural'
- (12.6) 'Semi-routine clerical'
- (12.7) 'Semi-routine childcare'
- (13.1) 'Routine sales'
- (13.2) 'Routine production'
- (13.3) 'Routine technical'
- (13.4) 'Routine operative'
- (13.5) 'Routine agricultural'

These can then be collapsed into 13 major categories. They can also be collapsed further into 7 classes (1,2,3=1) | (4,5,6=2) | (7=3) | (8,9=4) | (10,11=5) | (12=6) | (13=7) |

- 'Hi managerial/professional'
- 'Low managerial/professional'
- 'Intermediate'
- 'Small employer and self-employed'
- 'Low supervisors and technical'
- 'Semi-routine'
- 'Routine'

And, finally collapsed further into 5 classes (1,2=1) | (3=2) | (4=3) | (5=4) | (6,7=5) |

- 'Managerial and professional'
- 'Intermediate'

- 'Small employer and self-employed'
- 'Low supervisors and technical'
- 'Semi-routine and routine'

The five-class variable was used. This was used in to produce parsimony and because individual cell counts in each category would be too low if a variable with more categories was used. Using this information, the five-class structure was reverse recoded and the highest social class for the main parent and partner parent was derived. This provided a household social class level, using the highest social class from each parent in the household.

Ethnicity.

The MCS creates a derived ethnicity variable for each cohort member. This can take the form of an 11 category, 8 category, or 6 category grouping; this research used the 6 categories of ethnicity for reasons of parsimony. These categories are as follows:

- 'White'
- 'Mixed'
- 'Indian'
- 'Pakistani and Bangladeshi'
- 'Black or Black British'
- 'Other Ethnic group (inc. Chinese, Other)'

Section 3.6.4 stresses the care that needs to be taken when using and interpreting the ethnicity variable.

Income.

The MCS collected information on the main and partner parents' gross earnings at each sweep. From this information, the MCS calculate the OECD equivelised weekly family earnings. This is done by "dividing the total net household income, with the number of household members, according to their weight on the OECD equivelised income scale (equivelised household size) to give net disposable income" (Agalioti-Sgompou et al., 2017, p.49). From this information, the datasets at each sweep provide 4 income variables:

- Continuous equivelised income scale;
- Whether the family was above or below the 60% median income level;
- Where they fell in UK wide quintiles based on UK income distribution;
- Where they fell in country quintiles based on country income distribution.

The current research made use of the continuous equivelised income scale; this was used in order to determine how a one-unit change in equivelised income impacted the likelihood of the dyslexia label.

Education level.

Highest National Vocational Qualification (NVQ) uses the parents' highest academic or vocational qualification level. The qualifications are aggregated into a five-point scale:

- **NVQ level 5:** Higher Degree and Postgraduate qualifications; Post-graduate Diplomas and Certificates; Professional qualifications at degree level e.g. graduate member of professional institute, chartered accountant or surveyor.
- **NVQ level 4:** First Degree (including B.Ed.); Diplomas in higher education and other higher education qualifications; Teaching qualifications for schools or further education (below degree level); Nursing or other medical qualifications (below degree level); HND, HNC, Higher Level BTEC/RSA Higher Diploma.
- **NVQ level 3:** A/AS/S Levels/SCE Higher, Scottish Certificate Sixth Year Studies, Leaving Certificate or equivalent; NVQ or SVQ level 4 or 5; NVQ or SVQ Level 3/GNVQ Advanced or GSVQ Level 3; OND, ONCM BTEC National, SCOTVEC National Certificate; City & Guilds advanced craft, Part III/RSA Advanced Diploma.
- **NVQ level 2:** O Level or GCSE grade A-C, SCE Standard, Ordinary grades 1-3 or Junior Certificate grade A-C; NVQ or SVQ Level 2/GNVQ Intermediate or GSVQ Level 2; BTEC, SCOTVEC

- first or general diploma; City & Guilds Craft or Part II/RSA Diploma.
  - **NVQ level 1:** CSE below grade 1/GCSE or O Level below grade C, SCE Standard, Ordinary grades below grade 3 or Junior Certificate below grade C; NVQ or SVQ Level 1/GNVQ Foundation Level or GSVQ Level 1; BTEC, SCOTVEC first or general certificate/SCOTVEC modules; City & Guilds part 1/RSA Stage I,II,III/Junior certificate

Using this information, the highest NVQ level for the main parent and partner parent was derived. This provided a household NVQ level, using the highest NVQ household member's status. This is the same variable used in Parsons and Platt (2018) when controlling for family background.

When entering the variable into the model it became clear that the variance inflation factor (VIF) for highest NVQ level was unusually high (VIF discussed in detail in section 5.2.2). From looking at the data, this was because there were very few dyslexic cohort members whose parents' education level was level 1 (the lowest level). Table 5.11 shows the number of cohort members with dyslexia for each education level.

Table 5.11 Number of dyslexic cohort members at parents' highest education level

	NVQ Level				
Age	Level 1	Level 2	Level 3	Level 4	Level 5
7	6	48	31	62	24
11	15	39	37	95	48
14	7	45	44	124	46
Hybrid	30	107	89	217	94

This shows that there was an unbalanced distribution among the variable meaning that level 1 correlated highly with the model's constant term.

This problem was overcome by entering the variable as a continuous variable rather than a categorical variable. As there was an underlying hierarchy to the NVQ levels it was possible to enter the variable as a continuous variable. Therefore, rather than looking at how membership of each category predicted dyslexia, the results provided information on how a one unit increase in parents' education level, impacted the likelihood of the cohort member having dyslexia.

Age in year group.

While named the 'season of birth' or 'summer birthday' effect, the key aspect that impacts these differences is not the season that the child is born in, but how old they are in the year group. Therefore, a variable was created that reflected the child's age in the year group, as opposed to their season of birth. This was done by allocating those who would be the oldest in the year 12 (i.e. those born in September), and those youngest a 1 (i.e. those born in August). However, this does not consider that, parents of children who are young in their year group can choose to defer their school entry to the following year. Therefore, a second variable was created which provided information on how old the child was when they started school full-time. This was created using the child's month and year of birth, along with the parents' report of the month and year that the chid started school full time. The variable was created in months and ranged from children starting school at 35 months (2.9 years) to 70 months (5.8 years) with an average of 56 months (4.7 years). Using this information, those that started school younger than 4 years (47 months) and older than 5 years (60 months) were excluded from the analysis. This meant that age in year group according to month of birth could be examined.

Older sibling/ Child order.

Whether or not the cohort member had an older or younger sibling was derived using the 'household grid' dataset in which all of the members of the child's household were listed. Details of the relationship between the household member and the cohort member was provided, along with each household member's age. Using this information whether or not the child has an older or younger sibling was derived, along with the child order:

- Only Child
- Youngest
- Middle
- Oldest
- Twin or triplet

Country.

In order to examine the effect of either living in England or in Wales the child's country at sampling and country at interview were used. Those who did not have the same country at both sampling and the time of the interview were coded as missing and were not included in the analysis. This ensured that the impact of consistently living in one country was being examined. Should the cohort member have moved country between samples, it would not have been clear which country was influencing their outcomes.

Fee-paying school.

In each survey, the main parent was asked to state whether or not the child attended a fee-paying school. This response allowed the creation of the 'fee-paying school' variable.

Multi-sweep variables.

As the 'dyslexic hybrid' group contained all those labelled with dyslexia at ages 7, 11 and 14 it was necessary to create variables which gave detail about the children's demographic factors over these three sweeps. As this information can fluctuate over time, it was not appropriate to simply choose one sweep and use the data from this sweep. Furthermore, as the majority of variables were categorical, it was not appropriate to create an average over the three sweeps. Therefore, the following rules were applied to create each variable:

- If there was data for all three sweeps take the mode;
- If there was data for all three sweeps, and all three sweeps differed, take the median;
- If there was data for two sweeps take the mode;
- If there was data for two sweeps and the two sweeps differed, take the highest;
- If there was data for one sweep, keep the same.

Table 5.12 shows the social class data for the first 5 children in order to exemplify this.

Table 5.12 Recoding of hybrid variables (first five cases)

Child number	Social class at age 14	Social class at MCS5	Social class at age 7	Social class hybrid
1	5	2	2	2
2	.	.	5	5
3	4	3	5	4
4	.	2	1	2
5	.	5	5	5

(. = missing)

For continuous variables the average was taken.

Ability.

In order to find out what factors contributed to whether or not a child had a label of dyslexia, it was necessary to control for the child's ability. Therefore, the latent variable 'ability' was created. Cognitive ability tests have been included in each sweep of the MCS since MCS2 (age 3), therefore, a significant amount of information was available about the child's cognitive ability. As this thesis is interested in how individuals with similar 'initial states' can end up with different outcomes (i.e. being labelled with dyslexia, or not) early cognitive tests were used to create the ability variable which represented an initial ability. Cognitive tests up to and including MCS4 (age 7) were used to create the latent variable.

The MCS provided standardised and t-scores for each cognitive test. As well as being standardised, these scores are adjusted for the child's 3-month age grouping, this allowed the child's age at the time of the test to be controlled for. Furthermore, standardised scores minimized the impact of different variable scaling on fitting model invariance.

To create the latent ability variable, confirmatory factor analysis (CFA) under maximum likelihood estimation (ML) was performed.

5.1.8 Confirmatory factor analysis

CFA is a theory driven, confirmatory technique. It uses observed variables, to create an unobserved latent variable. Deciding which variables to use is driven by theory which suggests that the observed variables have a relationship with the unobserved variable. In the case of ability, we can theorise a model in which a 'general ability' factor influences performance in all of the cognitive tests issued.

Therefore, we predict that all of the cognitive results load onto the latent variable 'ability'. In this case the observed variables were the standardised scores from the cognitive tests included at age 3, 5 and 7. These were:

- *Age 3 Naming vocabulary* (C1): child was shown pictures of objects and was asked to name them.

- *Age 3 Bracken school readiness* (C2): child was shown colours, letters, numbers, sizes, comparisons, and shapes and was asked to name them.

- *Age 5 Pattern construction* (C3): child constructed a design by fitting together flat squares of solid cubes.

- *Age 5 Naming vocabulary* (C4): child was shown pictures of objects and was asked to name them.

- *Age 5 Picture similarity* (C5): child was shown four pictures and was asked to select a fifth picture which was most similar to the four previously shown.

- *Age 7 Word reading* (C6): child read a series of words, written on cards, out loud.

- *Age 7 Pattern construction* (C7): child constructed a design by fitting together flat squares of solid cubes.

- *Age 7 Maths ability* (C8): child was given a series of maths questions.

Table 5.13 shows the correlation table for the cognitive tests included. Average to strong correlations were shown between each cognitive test supporting the hypothesis that there may be a 'general ability' factor which influenced results on all tests.

Table 5.13 Correlations of cognitive variables

	C1	C2	C3	C4	C5	C6	C7	C8
C1	1.00							
C2	0.58	1.00						
C3	0.25	0.31	1.00					
C4	0.55	0.50	0.31	1.00				
C5	0.20	0.24	0.31	0.30	1.00			
C6	0.28	0.42	0.31	0.34	0.21	1.00		
C7	0.29	0.38	0.40	0.37	0.31	0.50	1.00	
C8	0.27	0.33	0.53	0.30	0.28	0.31	0.46	1.00

CFA asks how well the model fits the data. Figure 5.1 shows a predicted model of ability. The 'e' on the model is the error term. This explains the amount of variance in the cognitive scores that is not explained by the latent variable 'ability'.

Figure 5.1 CFA predicted model
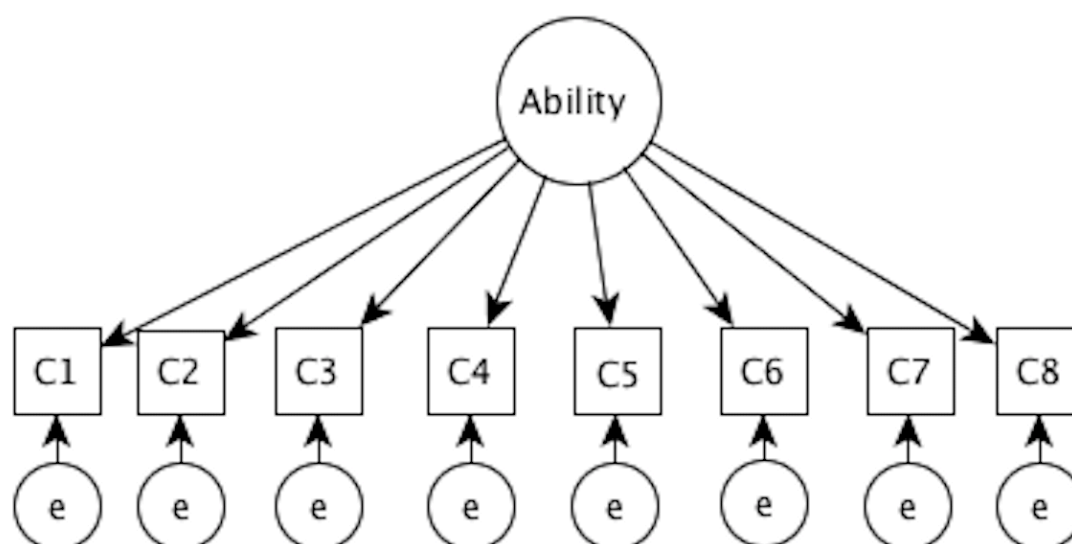
In order to estimate the parameters in the model the maximum likelihood (ML) method was used. ML implies that the model is as close as possible to the empirical covariance matrix (as close as possible to the observed data). To do this ML compares the 'model implied covariance matrix' with the 'observed covariance matrix' from the actual data. It then finds the parameter values that maximize the likelihood of making the observations given the parameters. Therefore, it finds the most probable model.

The model was analysed using the SEM builder on Stata IC. As there was missing data due to attrition from the cohorts, the Maximum Likelihood with Missing Values (MLMV) method was used so that cases were not omitted from the analysis. Using MLMV assumes that the data was either missing completely at random (MCAR) or missing at random (MAR). This meant that the probability that the data were missing on a particular variable did not depend on the value of that variable. Whilst the MCS report that attrition is more likely in some groups (e.g. disadvantaged; young; long working hours), the relationship between being in one of these groups and performance on cognitive scores should not be

interdependent. Therefore, in the case of cognitive scores we can assume that the missing data was MAR.

Model testing

The first model tested used all seven cognitive tests that were included in the dataset up to, and including, age 7 (Figure 5.2). Table 5.15 shows the goodness of fit statistics for this model. Table 5.14 shows the desirable level for each of the goodness of fit statistics (adapted from Schreiber et al., 2006). An ideal model would have error terms of 0, as the variance in the cognitive scores would be explained entirely by the latent variable. However, it is clear from the error terms that large amounts of variance were unexplained by the initial model (see Figure 5.2). The most widely accepted goodness of fit indicator is the root mean square error of approximation (RMSEA) as it is adjusted for model parsimony and, therefore, prefers the most parsimonious model possible. As is clear from Table 5.15 the first model did not meet the goodness of fit criteria. This suggests that model 1 is not a good fit.

Figure 5.2 CFA model 1
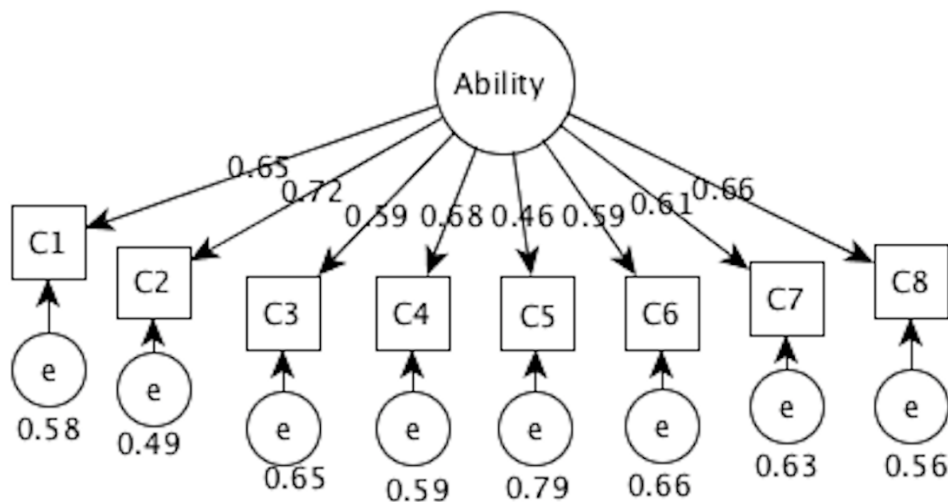
A reason for the latent variable not explaining some of the variance in the individual cognitive scores may be due to errors being individually correlated with one another. Model 1 did not allow these error terms to correlate. However, the specification of correlated errors may be justified on the basis of method effects (Brown, 2014). In the case of the current model, it was realistic to expect

that performance in *Age 3 Naming Vocabulary* (C1) and *Age 5 Naming Vocabulary* (C4) were correlated; and, that performance in *Age 5 Pattern Construction* (C3) and *Age 7 Pattern Construction* (C7) were correlated. Therefore, model 2, allows these error terms to be correlated (Figure 5.3).

Figure 5.3 CFA model 2
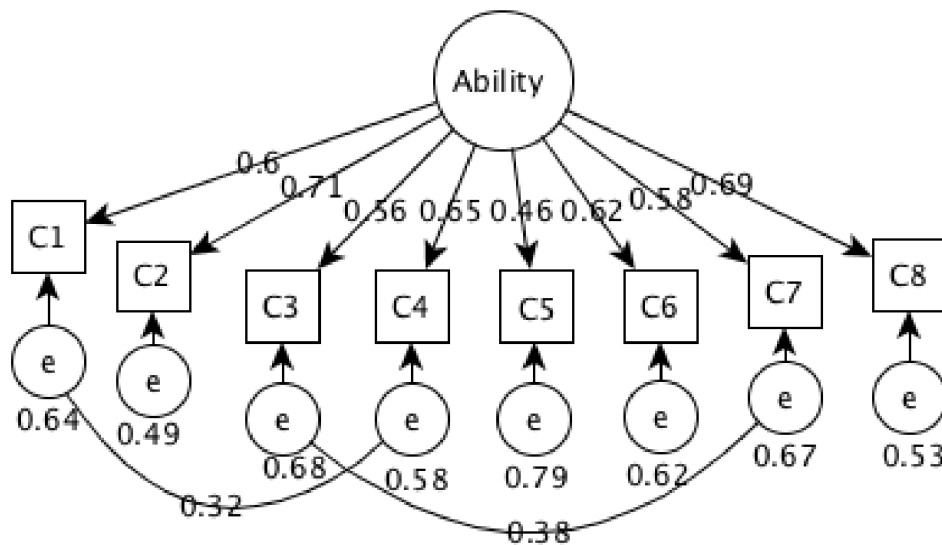
Table 5.15 shows that while model 2 is a slight improvement on model 1, it did not meet all of the criteria. Another method effect may come from correlation between tests at similar ages. In particular, it could be theorised that performance in *Age 3 Naming Vocabulary* (C1) and *Age 3 Bracken School Readiness* (C2) would be highly correlated as both tests required the child to identify and name different elements (objects in C1; colours, letters, numbers, sizes and shapes in C2). Therefore, model 3 correlated these error terms (Figure 5.4).

Figure 5.4 CFA model 3
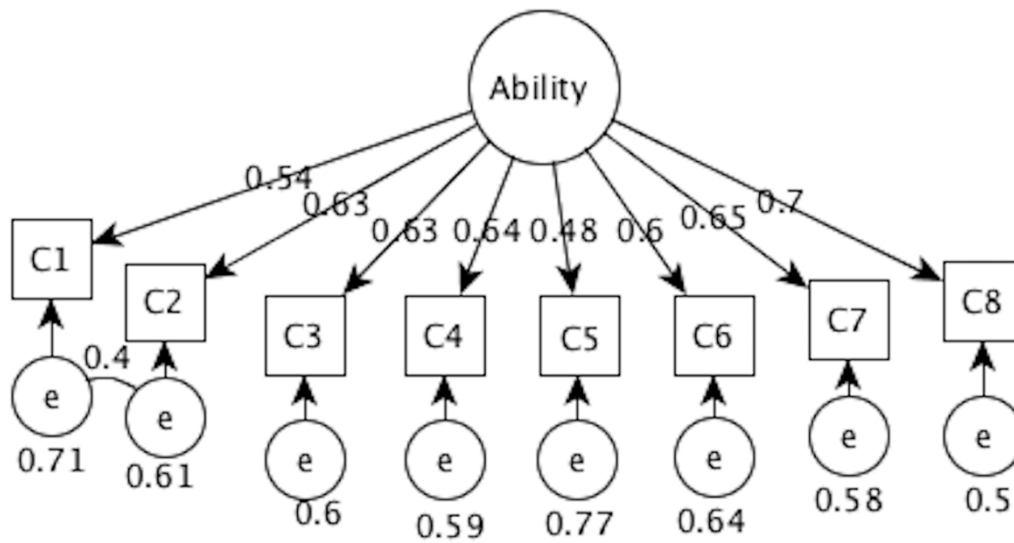
Table 5.15 shows that, again, while this was a slight improvement on model 1, it did not fit as well as model 2. Therefore, model 4 contained both the correlations between C1 and C4, C1 and C2, and, C3 and C7 (Figure 5.5).

Figure 5.5 CFA model 4
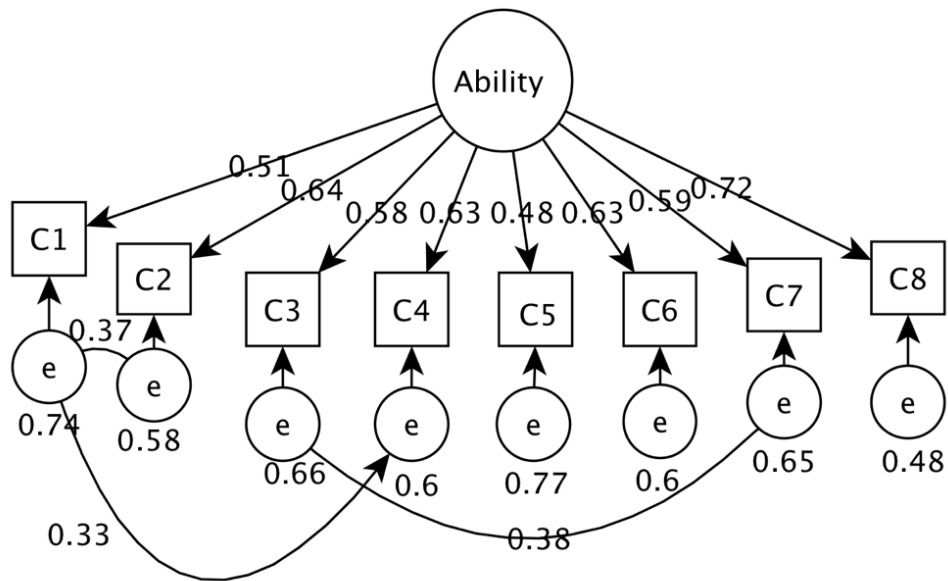
Figure 5.6 CFA model 4 with squared multiple correlation (SMC) values
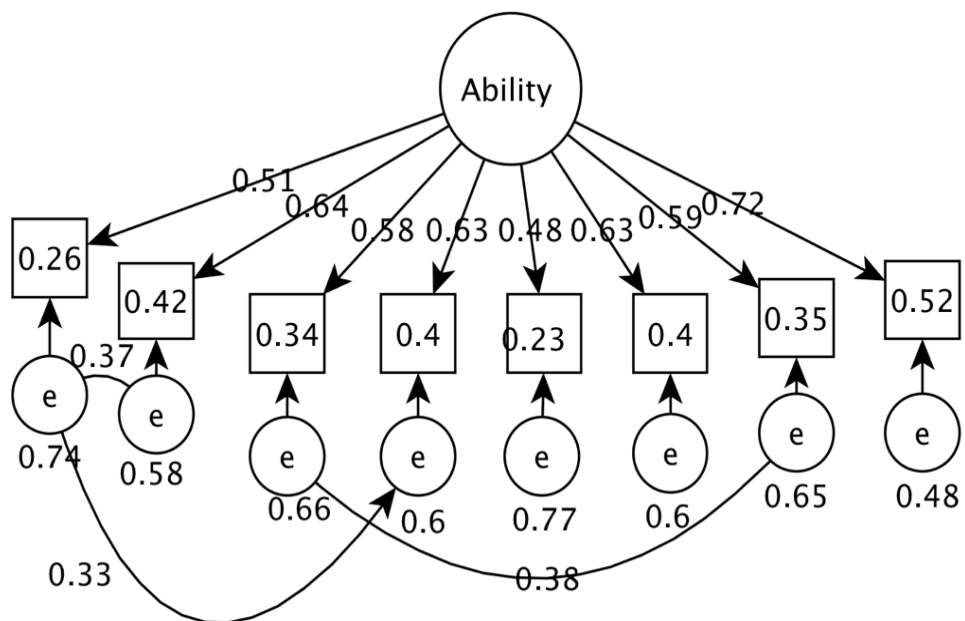
Table 5.14 CFA model fit criteria

Indexes	Shorthand	General rule for acceptable fit if data are continuous
Chi-Square	X^2	Non-significant
Bayes information criteria	BIC	Smaller the better
Comparative fit index	CFI	> 0.9 for acceptance
Tucker Lewis index	TLI	> 0.9 for acceptance
Root mean square error of approximation	RMSEA	<0.06 to 0.08 with confidence interval.

(Table adapted from Schreiber et al. 2006)

Table 5.15 CFA model statistics

Models	X^2	df	p	CFI	TLI	RMSEA (90% CI)	BIC
1	5782.84	20	<0.001	0.827	0.758	0.129 (p<0.001)	884642.53
2	3365.29	18	<0.001	0.9	0.84	0.104 (p<0.001)	882042.91
3	4206.07	19	<0.001	0.875	0.815	0.113 (p<0.001)	883075.51
4	1693.06	17	<0.001	0.95	0.917	0.076 (p<0.001)	880582.01

Model 4 again showed an improvement. Furthermore, most of the goodness of fit criteria were met. The only unfulfilled criterion was the non-significant chi-square test. However, Tanaka (1987) stated that if the sample is larger than 100, the chi-square test does not allow for the complexity that the sample will be showing, and therefore, is not an accurate measure of fit. Furthermore, the chi-square statistic for model 4 was significantly smaller than the other three models suggesting a large improvement in how well the model fitted the observed data. Therefore, these values indicated that model 4 showed a good fit between the model and the observed data.

Figure 5.6 shows the squared multiple correlation (SMC) values. These indicate the reliability of the measure. An example of an interpretation is the latent variable ability accounts for 52% of the variance in C7 (maths ability).

Using this model, estimated factor scores for 'ability' for each child were produced. Therefore, the child's predicted ability score was determined using model 4. Acquiring these predicted probabilities using CFA ensured that the

scores were an accurate reflection of the observed data, and therefore each individual's predicted score fitted their results. Furthermore, it allowed a standardised ability score to be created. Using these scores gave a continuous measure of ability. The scores were also converted into a categorical ability variable so that the children were also separated into quartiles based on their overall ability (Table 5.16).

Table 5.16 Ability quartiles

Ability Quartile	Range of Raw Ability Score	Number
Bottom 25%	6.43 – 43.06	4,872
25% - 50%	43.06 – 45.47	4,872
50% - 75%	45.47 – 49.18	4,872
Top 25%	49.18- 63.85	4,872

Justification of ability measure. The latent variable was derived to control for ability. This was required in order to isolate measures such as social class, and parents' educational level. For example, it might have been found there was no relationship between dyslexia and social class, but this may have been due to the relationship between social class and ability, and not due to there being no relationship between dyslexia and social class.

Furthermore, within this variable, measures were included which provided aspects that may correlate with the common 'symptoms' of dyslexia. For example, tests such as 'word reading ability' were included to create the latent measure as it was expected that performance in these tests would correlate with dyslexia. Additionally, many of the cognitive tests that were included involved processing speed which has also be shown to be corelated with dyslexia (Section 2.3.2). Thus, this allowed creation of a variable that allowed us to ask: despite the presence of 'dyslexic-type symptoms', what else is a predictor of dyslexia? Using this measure combined a means to both control for overall ability, and control for aspects that may be related to dyslexia.

As the ability variable was used to match cohort members during propensity score matching, it was necessary to have a variable that correlated with academic ability so that cohort members of both similar underlying ability, and similar academic outcomes were compared. Using the NPD data for England, it was possible to see how well the ability variable correlated with Key Stage 2

(KS2) outcomes. Cohort members were given points for the level that they achieved at KS2 English and Maths (1= working towards level 1; 2 = Level 2; 3 = Level 3; 4= Level 4; 5= Level 5). Using this measure, maths and English achievement were correlated with the latent ability variable for cohort members in England. Table 5.17 shows these correlations.

Table 5.17 Correlation between latent ability variable and KS2 grades

	Ability	
	r	n
English KS2	0.55	7,444
Maths KS2	0.59	7,386

*n = number of observations used to calculate the correlation coefficient.

Table 5.17 shows a moderate positive correlation between the ability score generated and KS2 grades in England. This, therefore, showed that this variable could be used as an indication of both general ability and that assumptions could be made about its relationship with academic outcomes.

5.2 Analysis methods

5.2.1 Bivariate analysis

Following the initial selection of variables of interest bivariate analysis was carried out using the Stata software. The purpose of bivariate analysis was to establish whether there was any relationship between the different variables. Bivariate analysis of categorical variables was done using chi-square tests (X^2). X^2 tests compare whether there is a significant difference between the expected value and the observed value in each sub-category or 'cell'. However, while the overall X^2 result can tell us that there is a significant relationship between the variables, "chi-square does not provide information about the strength of an association or its direction" (Platt, 2004, p,124). Therefore, adjusted standardised residuals can be calculated which can identify which cells are making a significant contribution to the result. A residual is the difference between the observed and the expected values for each cell. These raw residuals can be standardised by "dividing the raw residual by the square root of the expected value as an estimate of the raw residuals standard deviation" (Sharpe, 2015).

Therefore, the sum of the standardised residual is the chi-square value. These numbers can also be adjusted using the following equation (O=observed value; E=expected value):

$$\frac{(O - E)}{\sqrt{(E * \left(1 - \frac{RowMarginal}{n}\right) * \left(1 - \frac{ColumnMarginal}{n}\right))}}$$

In this equation, the denominator is the estimated standard error (Sharpe, 2015). Adjusted standardised residual scores that are larger than ±1.96 show that that cell is significantly different to what would be expected by chance.

Bivariate analysis of continuous variables was done using t-tests. T-tests compare whether there is a significant difference between the means of different groups.

An issue with bivariate analysis is that it can produce statistically significant results with a large sample size, even with a small effect. It also does not take into account any other variable which may be influencing the relationship between the two variables examined.

5.2.2 Logistic regression

In order to investigate which factors were significant predictors of dyslexia, binary logistic regression was used. Regression analysis allowed exploration of how a predictor variable related to the dependent variable, while taking the other variables in the model into account. Regression analysis looked for unique variation in the variable, which was explained by the predictor variable. As the dependent variable was binary and categorical (labelled as dyslexic/ not labelled as dyslexic), binary logistic regression was used.

In regular regressions, R-squared (R^2) can be calculated. R^2 is a measure of how close the data are to the to the regression line. Therefore, it can tell us how well the model fits the data. When regression is conducted with survey data R^2 cannot be accurately calculated. This is because calculation of R^2 assumes that the data is identically and independently distributed. However, in survey data, due to the sampling weights this cannot be assumed (when there are population weights the 'randomness' of the weighted sample cannot be assumed). Consequently, R^2 is not valid in weighted survey data. However, a Wald statistic can be produced to measure model fit; this is a test of the null hypothesis. The null hypothesis assumes that all slope parameters are jointly equal to zero. Therefore, if the Wald

statistic is significant we can reject the null hypothesis and state that there is a significant relationship between the predictor and dependent variables.

In this study 'backwards logistic regression' was used. This procedure involved all possible variables being entered into the model initially and the insignificant variables being removed individually. The backwards method was chosen as forward approaches could result in a more significant variable suppressing the effects of less significant variables so that they do not appear to be significant.

Logistic regression produces odds ratios -- the ratio between two sets of odds. Odds ratios can be defined as the probability of an event occurring, divided by the probability of an event not occurring.

Marginal effects. Odds ratios can be difficult to interpret. This is because odds ratios above one appear to show a larger relative risk to odds ratios below one (Davies, Crombie & Tavokoli, 1998). Therefore, odds ratios can be converted into marginal effects which are the predicted probability of an event occurring. Using these it was possible to interpret the probability of a cohort member in a certain group (e.g. having an older sibling) meeting the regression criteria (e.g. having dyslexia) and compare it with the probability of those not in the group (e.g. no older sibling) meeting the regression criteria (Davies, Crombie & Tavokoli, 1998). This is the marginal effect. The results presented in this thesis have been calculated using average marginal effects (AMEs). AMEs are calculated as follows:

> 1. Generate a logistic regression model for dyslexia, including age in year group as one of the predictors.
>
> 2. Start at the first cohort member in the dataset.
>
> 3. Use the regression model to calculate a predicted probability that this cohort member is dyslexic, using their characteristics to set the values for all factors in the model except for older sibling: set this factor to be 'no older sibling'. Record the predicted probability generated by the model for that cohort member.
>
> 4. Repeat for all the other cohort members in the dataset.
>
> 5. Take the mean of the predicted probabilities made for all these cohort members. This is the average adjusted predicted probability of being dyslexic having a summer birthday.
>
> 6. Do steps 2 to 4 again, except this time setting the age in year group factor for each person as being 'older sibling'.

7. Take the mean of the predicted probabilities made for all these people. This is the average adjusted predicted probability of being dyslexia for cohort member with an older sibling.

8. The difference between the two mean predicted probabilities calculated at steps 5 and 7 is the AME age in year group on being dyslexic.

(Adapted from, Knight, 2017, p.3-4)

Whilst some of the variables in all of the sweeps showed a significant relationship with dyslexia in bivariate analysis, it was also important to understand how that variable contributed to dyslexia when holding other predictor variables constant. In particular, it was of interest to investigate the significant predictors when holding ability constant. This was because it was then possible to determine what variables, other than ability, were a predictor of having a label of dyslexia. In other words, if two people had the same ability, what factors predicted why one may have had a label of dyslexia while the other did not.

Collinearity and multicollinearity between variables. Before regression analysis could be carried out certain assumptions needed to be satisfied. Most importantly was the issue of collinearity (when two predictor variables are correlated) and multicollinearity (when two or more predictor variables are inter-correlated). Collinearity and multicollinearity are a problem because if two predictor variables are closely related, it can be hard to disentangle which variable may be causing the effect on the dependent variable. If one variable is slightly stronger than the other then it can make the second variable appear to be insignificant when it is, in fact, an important component in predicting the dependent variable (Knight, 2017). Therefore, if collinearity is present claims about the importance of a predictor variable would be untrustworthy.

In order to determine whether there were any strong associations between predictor variables, correlation statistics were generated for each sweep. Tables 5.18-5.21 show these correlation statistics.

Table 5.18 Age 7 correlations

	Age in year	Older sibling	Child order	Fees	Income	NVQ	Social class	Ability	Sex
Age in year	1.00								
Older sibling	0.01	1.00							
Child order	0.00	-0.30	1.00						
Fees	0.0	-0.01	0.00	1.00					
Income	0.00	-0.03	0.02	0.18	1.00				
NVQ	-0.01	-0.01	0.05	0.15	0.42	1.00			
Social class	-0.01	0.02	0.05	0.13	0.47	0.52	1.00		
Ability	-0.07	-0.06	0.02	0.09	0.23	0.24	0.25	1.00	
Sex	-0.01	0.01	-0.02	0.01	-0.01	0.00	-0.01	-0.15	1.00

Table 5.19 Age 11 correlations

	Age in year	Older sibling	Child order	Fees	Income	NVQ	Social class	Ability	Sex
Age in year	1.00								
Older sibling	0.01	1.00							
Child order	-0.00	-0.47	1.00						
Fees	-0.00	-0.03	0.00	1.00					
Income	0.01	-0.10	-0.07	0.20	1.00				
NVQ	-0.03	-0.05	0.05	0.15	0.55	1.00			
Social class	-0.00	-0.05	0.01	0.17	0.30	0.38	1.00		
Ability	-0.08	-0.07	0.02	0.10	0.26	0.22	0.19	1.00	
Sex	-0.01	0.01	-0.01	0.00	-0.01	0.01	0.00	0.08	1.00

Table 5.20 Age 14 correlations

	Age in year	**Older sibling**	**Child order**	**Fees**	**Income**	**NVQ**	**Social class**	**Ability**	**Sex**
Age in year	1.00								
Older sibling	0.01	1.00							
Child order	-0.00	-0.37	1.00						
Fees	-0.00	-0.02	-0.01	1.00					
Income	0.01	-0.13	-0.05	0.20	1.00				
NVQ	-0.03	-0.03	0.03	0.15	0.53	1.00			
Social class	0.01	-0.03	0.00	0.13	0.48	0.47	1.00		
Ability	-0.07	-0.07	0.01	0.10	0.26	0.21	0.23	1.00	
Sex	-0.02	-0.01	-0.00	0.01	-0.01	-0.00	-0.01	0.08	1.00

Table 5.21 Hybrid correlations

	Age in year	**Older sibling**	**Child order**	**Fees**	**Income**	**NVQ**	**Social class**	**Ability**	**Sex**
Age in year	1.00								
Older sibling	0.00	1.00							
Child order	-0.00	-0.41	1.00						
Fees	0.00	-0.03	-0.01	1.00					
Income	0.00	-0.10	-0.05	0.22	1.00				
NVQ	-0.02	-0.04	0.03	0.16	0.53	1.00			
Social class	-0.01	-0.03	0.00	0.15	0.53	0.49	1.00		
Ability	-0.06	-0.07	0.02	0.10	0.30	0.24	0.25	1.00	
Sex	-0.01	0.01	-0.01	0.00	-0.01	-0.00	-0.01	0.07	1.00

A correlation was shown between child order and having an older sibling. Furthermore, as discussed in Section 4.3.3 there was an expected mild correlation between ability, social class, NVQ and income. Collinearity between two variables is considered to be a problem if the correlation value is above 0.8 (Field, 2013). Tables 5.18-5.21 show that there were no obvious collinearity between the chosen variables. However, whilst none of the correlations were so strong that a variable needed to be removed from the model, it was important to bare these in mind in understanding multicollinearity issues in the regression model.

Multicollinearity can be tested using the VIF. The VIF measures how much variance in the regression model is inflated due to multi-collinearity. The Stata software calculated the VIF by regressing the predictor variable against the other predictor variables in the model. This produced the R^2 value for each predictor. The formula for calculating the VIF for each predictor is: $VIF = 1 \div (1 - R^2)$. Using this the average VIF for the model can be calculated. It is suggested that "if the largest VIF is greater than 10 then there is cause for concern" and "if the average VIF is substantially greater than 1 then the regression may be biased" (Field, 2013, p.325). The VIF for each predictor variable, and the average VIF was be reported and examined in each model. As it was not possible to compute the VIF within survey mode in Stata, the regression was run without survey mode but with the weights applied. It was possible to do this as the only part of the survey design that had an effect on collinearity was the weights. Therefore, these are still taken into account when this was applied.

5.2.3 Propensity score matching

Propensity score matching (PSM) can be done to compare outcomes for two matched groups. PSM is used a lot in medical research as it can compare those who have received a treatment with those who have not. In the case of this research it can be used to compare those who have received the label of dyslexia and those who have not. As opposed to individually matching participants with the same relevant characteristics, PSM uses a logit or probit model with a set of relevant covariates, to compute a child's 'propensities' or likelihoods of being labelled with dyslexia. Using each child's score, dyslexic children were matched with non-dyslexic children based on the proximity of their scores (explained in more detail below).

The 'dyslexic hybrid' variable was used for the PSM. As PSM looked for matches, it could be hypothesised that, if individual sweep data was used, someone that was not labelled as dyslexic in that particular sweep, but who had been labelled as dyslexic elsewhere, could have been included in the matched, non-dyslexic group. Therefore, it was possible that the non-dyslexic control group could contain those who had been labelled as dyslexic elsewhere. As the dyslexic hybrid group contained all those who had been labelled as dyslexic over the three sweeps, this resolved this problem.

Considerations for including variables. For PSM to work, it relies on the assumption that there is a detailed understanding of the process by which selection into the pseudo 'treatment group' takes place (i.e. having the dyslexic label). The initial part of this research focused on the characteristics which led to a person having a label of dyslexia. This knowledge allowed the selection of covariate variables to be used in the model.

Caliendo and Kopeing (2008) provide a number of prerequisites for including variables in the propensity score model. The propensity score model is the model of variables which are used to find individuals with matched characteristics. Caliendo and Kopeing (2008) state that "the outcome variable(s) [i.e. dyslexia], must be independent of treatment conditional on the propensity score" (p.38) Therefore, only variables that were unaffected by having dyslexia should be included in the model. The results from the previous logistic regression made it possible to fulfil this criterion. As dyslexia was the dependent variable in the logistic regression, it looked for predictors of dyslexia, and not the other way around. Therefore, the variables that were significant predictors of dyslexia in the logistic regression were unaffected by dyslexia itself.

In deciding how many variables to include in the model there is a trade-off between bias (i.e. the distance between the estimated effect of being labelled with dyslexia from the 'true effect' of being labelled with dyslexia) and efficiency/ variance (i.e. the precision of the estimated effect of being labelled with dyslexia.) For the current research, there were two possible options. The first option was that the propensity score was created using only the variables that were significant predictors of being in the 'dyslexic hybrid' group (i.e. Ability; Income; Older sibling; Sex; Parents highest social class). The second option was to use all the variables that were found to be significant predictors at any sweep (i.e. Ability; Income; Older sibling; Sex; Parents highest social class; Parents highest education level; Age in year). In order to find the best model tests could be done to explore how well the propensity scores were balanced across the treated and comparison groups. This was done by stratifying the sample into blocks and testing whether the mean propensity score was equal in both the treatment and comparison groups within each block. If it was not equal, the block could be split again and retested. Using the Stata software, the programme automatically continued to split the blocks and perform t-tests on each covariate, until it found the smallest number of blocks in which the propensity score was equivalent across the treated and control

groups in each block. Using the final number of blocks ensured that the mean propensity score was the same for the treated and control group in each block.

Once the number of blocks was determined, it was possible to test to ensure that the selected covariates were balanced across the treatment and comparison groups within each block. Table 5.22 shows that the model in which the dyslexic hybrid predictors were used was initially unbalanced due to the 'ability' variable in three of the four blocks. This may be due to the fact that the 'ability' variable was continuous, and the variance was large. Therefore, it was necessary to use the ability quartile variable. This categorical variable could then be entered as a covariate in order to match dyslexic children with children in the same quartile. Table 5.22 shows that once this new variable had been entered into the model the balancing property in this model was satisfied.

The same procedure was then repeated with all predictors of dyslexia at any sweep. Table 5.22 shows that the balancing probability was not satisfied with all variables. The recoded ability variable was entered, and the model was retested. Table 5.22 shows that this model used only 5 blocks meaning that it took fewer divisions for the mean propensity score to be the same for the treated and untreated group. Furthermore, the balancing probability was satisfied when including all of these variables. Table 5.23 shows the inferior bound, the number of treated and the number of controls for each block for this model.

Table 5.22 PSM blocks

	Number of blocks	Balancing property satisfied	Unbalanced variables
Dyslexic Hybrid predictors	7	No	Ability- Block 3 Ability- Block 4 Ability- Block 6
Dyslexic Hybrid predictors- Ability recoded	7	Yes	
All dyslexia predictors	8	No	Ability- Block 4 Ability- Block 7 Social class- Block 7 Income- Block 8
All dyslexia predictors- Ability recoded	5	Yes	

Table 5.23 PSM inferior block statistics

Inferior of block of propensity score	Non-dyslexic	Dyslexic	Total
0	7,296	104	7,400
0.025	3,594	139	3,733
0.05	2,943	227	3,170
0.1	743	108	851
0.2	14	2	16
Total	14,590	580	15,170

Choosing a matching algorithm. In order to obtain a non-dyslexic matched group, each dyslexic child was matched to one or more non-dyslexic children using their propensity score. There are various methods in which to match children. Furthermore, instead of matching, data can also be weighted in order to take into account the propensity scores. I will now discuss these methods along with their advantages and disadvantages. I will then discuss how I used all methods to test which worked best in the current research context.

Matching methods

Nearest neighbourhood matching: This is the most straightforward matching estimator. In this method, the child from the non-dyslexic comparison group is chosen for being the closest to the dyslexic child's propensity score. Nearest neighbourhood matching can happen with and without replacement. Either, the comparison child cannot be matched with more than one dyslexic child (non-replacement), or, they can. Allowing replacement allows the quality of the match to increase. However, it reduces the number of 'non-dyslexics' in the matched group. A problem with non-replacement matching is that it depends on the order that the children get matched (i.e. if someone is already matched, they cannot be matched again). Therefore, when using this approach participants need to be randomly ordered.

When using Stata, nearest neighbours are not determined by comparing treated observations to every single control, but by first sorting all records by the estimated propensity score and then searching forward and backward for the closest control unit(s); if for a treated unit forward and backward matches happen

to be equally good, Stata will randomly draw either the forward or backward match.

A key problem with nearest neighbourhood matching is that is risks bad matching if the closest neighbour is far away.

Radius Matching: Radius matching address the problem that the nearest neighbour could be far away, by applying a tolerance level on the maximum propensity distance. The suggested distance is 0.2 of the standard deviation of the logit of the propensity score. For the model in which all variables are included this is 0.12. However, this seems fairly large, therefore, a smaller caliper can be used to ensure that matching is as precise as possible. Therefore, a caliper of 0.0001 was used, as this is what has been used in similar PSM studies using the MCS (Taylor, Rees & Davies, 2013).

The advantages of this model are that it improves the comparability of the groups, meaning that there is less bias. However, as this model also drops the children who do not fall within the caliper there is more variance.

Kernel Weighting: This method of matching use weighted averages of individuals in the control group to construct the counterfactual outcome. Weights depend on the distance between the dyslexic and non-dyslexic control groups. The weights place a higher weight on a child closer to the dyslexic child and a lower weight on those who are more distant.

In the perfect world, all matching methods should yield the same results as all would compare exact matches. However, as the sample size decreases, this becomes less likely. Therefore, initially, all aforementioned approaches were applied to compare the results.

In order to explore the preferable matching method, the variable 'I think I am good at English' was used as the outcome variable (see Section 6.3 for all PSM results). The result was the measure of the average treatment effect for the treated individuals (ATT). In this case it was the average effect of having the dyslexic label compared to not having the label.

Table 5.24 shows the mean for the matched non-dyslexic group, the dyslexic group and the associated t-statistic. These are shown firstly for the unmatched group, followed by matching with nearest neighbourhood, radius

matching and kernel weighting. Following the analysis, it is possible to evaluate the balance in the sample by looking at the standardized differences in the covariates. Table 5.25 shows the reduction in bias for each matching method, followed by the mean and median bias. The table also includes Rubin's B and R. Rubin's B is the "absolute standardised difference of the means of the linear index of the propensity score in the treated and non-treated group" (Rubin, 2001) it is suggested that this should be less than 25. Rubin's R is "the ratio of the treated to non-treated variances of the propensity score index" (Rubin, 2001), this should be between 0.5 and 2 for the samples to be considered balanced.

Table 5.24 PSM 'I am good at English' for each matching method

Matching/ weighting method	Dyslexic	Controls	Difference	Std. Err.	T-stat
Unmatched	2.63	3.06	-0.43	0.03	-12.73
Nearest neighbour (no replacement)	2.63	3.01	-0.37	0.05	-8.16
Nearest neighbour (with replacement)	2.63	3.03	-0.39	0.05	-8.46
Radius matching	2.63	3.02	-0.38	0.04	-9.91
Kernel weighting	2.63	3.04	-0.40	0.03	-11.92

Table 5.25 PSM bias reduction for each matching method

		Un-matched	Nearest neighbour (no replacement)	Nearest neighbour (with replacement)	Radius matching (caliper 0.0001)	Kernel weighting
Bias reduction (%)	Ability	-	83	76.7	75.7	22.9
	Income	-	91.2	79	68.1	84.2
	Sex	-	97	98.5	97.9	60.0
	Older sibling	-	71.2	74.4	79.5	35.5
	Social class	-	86.4	67.2	80.1	81.9
	Age in year group	-	29.4	10	46.1	54.6
	NVQ	-	86.0	75.5	32.3	96.9
Mean bias		17.7	3.1	4.3	4.5	17.7
Median bias		13.7	1.6	3.8	5.2	31.7
Rubin's B		65.6	9.4	11.9	11	65.6
Rubin's R		0.92	0.9	0.93	0.97	29.9
Number of dyslexic children dropped		-	-	-	27	-

Table 5.25 shows that Kernel weighting of the data did not meet Rubin's B criteria of falling below 25 therefore, this option was excluded. Comparing the other 3 matching options showed that radius matching had the highest mean and median bias, and 27 dyslexic children were dropped. Nearest neighbourhood matching with no replacement had less bias than with replacement. Furthermore, as a key aim was to match children on ability level, nearest neighbourhood matching with no replacement showed the largest reduction in bias for this variable. For these reasons, nearest neighbourhood with no replacement was used as the matching technique.

Propensity score matching for age 7 and age 11 results only. As well as comparing how dyslexia may affect the cohort member's own academic self-concept and aspirations, it was interesting to investigate what the cohort members' teachers and parents believed the child's aspirations should be. As the teachers were not questioned at age 14 it would not be correct to use the above propensity scores, as they included information from the age 14 sweep. Therefore, variables only using data from age 7 and age 11 were generated.

These took the mode or highest number from each sweep (explained in Section 5.1.6). These variables were then used to generate the children's propensity scores using the same method as above. For consistency, all of the same predictors were used. This balanced at 9 blocks with the balance property satisfied when using the categorical ability variable.

Adjusting standard errors. Abadie and Imbens (2006; 2008; 2011) suggest that when using nearest-neighbour matching methods, the standard error does not consider the level of uncertainty from the PSM estimate. Therefore, if this is ignored it makes standard errors for the ATT either more conservative of more generous. In order to counter for this, they suggest at a bias-corrected estimator that is consistent. This is applied to the calculations to adjust the standard errors.

Propensity score matching- dependent variables. The following variables were chosen to look at the effect of the label of dyslexia on the children studied.

Teachers report of ability. At age 11 the child's teacher was asked about their aspirations for the child. This was the same questionnaire in which the teacher reported dyslexia, therefore, the teacher was aware of the child having the dyslexic label. The teacher was asked "*How likely or unlikely do you think it is that [child's name] will go to university?*" They were required to choose from the options "very likely; fairly likely; not very likely; not likely at all".

Parents report of ability. At age 14 the main parent and partner parent were asked the same question as the teachers in age 11. This was "*how likely or unlikely do you think it is that [child's name] will attend university?*" parents were also given the options of "very likely; fairly likely; not very likely; not likely at all". As both parents were asked this question, the highest of both their responses was taken.

Child's report of ability. At age 14 the children were asked "*How much do you agree or disagree with each of the following statements about you?*" followed by "*I am good at English"; "I am good at science"; "I am good at physical education (PE)*". For each statement the chid could answer on a four-point scale from 'strongly disagree' to 'strongly agree'.

They were also asked *"how likely do you think it is that you will go to university?"* In order to answer this question, they were given a slider on a scale which ranged from 0-100% and were told to place the pointer where they felt fitted their response best.

5.3 Summary of chapter

The Millenniums Cohort Study (MCS) is a large-scale longitudinal dataset with a range of data and information on cohort members who were born in and around the year 2000. Using this data, variables were created providing information on the child's gender, parents highest social class, parents highest educational level, age in year group and child order. A variable for ability was also generated with CFA using the child's results on cognitive ability tests at ages 3, 5 and 7. Using these variables bivariate analysis and logistic regression were used to look for predictors of the dyslexia label. Following this PSM compared a dyslexic and non-dyslexic control group to look for differences in academic self-concept and the academic aspirations of both the child and their teachers and parents. Results of this analysis are presented in the following chapter.

CHAPTER 6

Millennium Cohort Study – Results

6 | Millennium Cohort Study – Results

The following section details the results of analysis using the Millennium Cohort Study (MCS).

6.1 Bivariate analysis

Bivariate analysis was used to initially determine whether there were any significant relationships between the label dyslexia and the predictor variables. The figures for each variable in each sweep are shown in tables 6.1 (for categorical variables) and 6.2 (for continuous variables).

6.1.1 Age ≈ 7

Social Class. There was no initial significant relationship between a cohort member being labelled with dyslexia and social class at age 7: $X^2(4)=5.02$, p=0.4.

Income. There was no significant difference in household income between cohort members who had been labelled dyslexic (Mdyslexic= 412.07) and those who had not (Mnon-dyslexic=386.87) at age 7: t=-1.11, p=0.27.

Education Level. There was also no significant difference in parents' highest education level between those who were labelled with dyslexia (Mdyslexic= 3.29) and those who were not (Mnon-dyslexic=3.26) at age 7: t=-0.38, p=0.7.

Ethnicity. Furthermore, there was no significant relationship between dyslexia and the cohort members ethnicity at age 7: $X^2(5)=16.80$, p=0.2.

Age in year group. No significant relationship was found between cohort members that were labelled dyslexic (Mdyslexic=6.48) and not dyslexic (Mnon-dyslexic=6.58) and their age in their year group at age 7: t=0.39, p=0.7 (12=Oldest, 1=Youngest).

Older Sibling. However, there was a significant relationship between dyslexia and having an older sibling at age 7, whereby **those who had an older sibling were significantly more likely to be labelled with dyslexia** than those who did not have an older sibling: $X^2(1)=12.15$, $p<0.01$.

Child Order. Furthermore, there was a significant relationship between dyslexia and child order age 7 whereby **those who were the oldest were less likely than expected to be labelled dyslexic; those who were a middle or youngest child were more likely than expected to be labelled dyslexic**: $X^2(3)=12.37$, $p=0.01$.

Fee paying school. A significant relationship was also found between dyslexia and attending a fee-paying school at age 7. **Those who attend a fee-paying school were significantly more likely to be labelled as dyslexic**: $X^2(1)=14.33$, $p<0.01$.

Sex. There was a significant relationship between dyslexia and sex at age 7: ($X^2(1)=20.44$, $p<0.01$). **Boys were significantly more likely to be labelled as dyslexic than girls.**

Country. There was no significant difference in whether the cohort member was dyslexic and whether they lived in England or in Wales at age 7: $X^2(1)=0.73$, $p=0.39$.

Summary of relationships at age 7. Bivariate analysis at age 7 showed that there was a significant relationship between having dyslexia and having an older sibling; being the middle or youngest child; attending a fee-paying school; and being male.

6.1.2 Age ≈ 11

Social Class. Firstly, no significant relationship was found between the dyslexia label and social class at age 11: $X^2(4)=8.8$, $p=0.12$.

Income. There was no significant difference in household income between cohort members who were labelled with dyslexia (Mdyslexic= 432.09) and those who were not (Mnon-dyslexic=417.67) at age 11: t=-1.21, p=0.23.

Education Level. There was also no significant difference in parents' highest education level between those labelled with dyslexia (Mdyslexic=3.44) and those who were not dyslexic (Mnon-dyslexic=3.32) at age 11: t=-1.27, p=0.2.

Ethnicity. There was also no significant relationship found between ethnicity and dyslexia at age 11: $X^2(5)= 9.59$, p=0.13.

Age in year group. No significant relationship was found between cohort members labelled dyslexic (Mdyslexic=6.12) and not dyslexic (Mnon-dyslexic=6.57) and their age in their year group at age 11: t=1.85, p=0.07 (12=Oldest, 1=Youngest).

Older Sibling. Similarly to age 7, there was a significant relationship between dyslexia and having an older sibling at age 11: $X^2(1)= 6,55$, p<0.01. **Those who had an older sibling were significantly more likely to be labelled dyslexic**.

Child Order. There was also a significant relationship between dyslexia and child order age 11: $X^2(3)=8.85$, p=0.05. **There were more dyslexic cohort members than expected who were the youngest child**. In contrast, there were **less dyslexic cohort members than expected who were the only child.**

Fee paying school. Again mirroring the results from age 7, there was a significant relationship between dyslexia and attending a fee-paying school at age 11: $X^2(1)=55.99$, p<0.001. **Those who attend a fee-paying school were significantly more likely to the be labelled with dyslexia.**

Sex. Likewise, there was a significant relationship between dyslexia and sex at age 11 whereby **males were more likely to be labelled with dyslexia than females**: $X^2(1)=34.41$, $p<0.01$.

Country. There was no significant difference in whether the cohort member was dyslexic and whether they lived in England or in Wales at age 11: $X^2(1)=1.06$, $p=0.37$.

Summary of relationships at age 11. Bivariate analysis of predictor variables and dyslexia at age 11 showed that the same variables that were significant predictors of dyslexia at age 7, were also significant at age 11 (having an older sibling; child order; attending fee-paying school; and, being male).

6.1.3 Age ≈ 14

Social Class. There was no significant relationship found between being labelled dyslexic and social class at age 14: $X^2(4)=2.48$, $p=0.8$.

Income. Furthermore, there was no significant difference in household income between cohort members who were labelled dyslexic (Mdyslexic= 391.7) and those who were not (Mnon-dyslexic=388.51) at age 14: t=-0.29, p=0.77.

Education Level. However, the **parents of those labelled with dyslexia** (Mdyslexic=3.43) **had significantly higher education levels** than those without the dyslexia label (Mnon-dyslexic=3.29): t=-2.0, p=0.05.

Ethnicity. Unlike at ages 7 and 11, a significant relationship was found between the dyslexia label and ethnicity at age 11: $X^2(5)=24.19$, $p<0.01$. At age 14 there were **less cohort members than expected whose ethnicity was Indian, Pakistani and Bangladeshi, and 'other'. There were more dyslexics than expected who were white.**

Age in year group. **Children labelled with dyslexia** (Mdyslexic=6.04) **were significantly younger in their year group** compared to non-dyslexic children (Mnon-dyslexic=6.55): $t=2.23$, $p=0.03$ (12=Oldest, 1=Youngest).

Older Sibling. Unlike age 7 and age 11 there was no significant relationship between the dyslexia label and having an older sibling at age 14: $X^2(1)=4.42$, $p=0.07$.

Child Order. Furthermore, there was no significant relationship between dyslexia and child order age 14: $X^2(3)=9.12$, $p=0.07$.

Fee paying school. Similarly to ages 7 and 11, there was a significant relationship between dyslexia and attending a fee-paying school at age 14: $X^2(1)=27.08$, $p<0.01$. **Those who attended a fee-paying school were significantly more likely to be labelled dyslexic.**

Sex. Once again, there was also a significant relationship between dyslexia and sex at age 14: $X^2(1)=27.56$, $p<0.01$. **Males were more likely to be labelled with dyslexia than females.**

Country: There was no significant relationship between being labelled with dyslexia and whether the cohort member living in England or in Wales: $X^2(1)=0.1$, $p=0.82$.

Summary of relationships in age 14. There were different significant relationships between dyslexia and the predictor variables in age 14. Having an older sibling and child order were no longer significant predictors of dyslexia at age 14. However, parents' highest education level, ethnicity and age in year group became significant predictors of dyslexia. Sex and attending a fee-paying school were continuously predictors of dyslexia at ages 7, 11 and 14.

6.1.4 Dyslexic hybrid

Social Class. Initial analysis showed a significant relationship between being labelled with dyslexia and social class: $X^2(4)=13.08$, $p=0.05$. **Those whose parents' highest social class was the managerial and professional class were more likely to have dyslexia** than those in the lower social classes.

Income. There was no significant difference in household income between cohort members who were labelled dyslexic (Mdyslexic= 392.3) and those who were not dyslexic (Mnon-dyslexic=378.46): $t=-1.59$, $p=0.1$.

Education Level. There was also no significant difference in parents' highest education level and whether the cohort member was labelled with dyslexia (Mdyslexic=3.32) or not (Mnon-dyslexic=3.22): $t=-1.63$, $p=0.1$.

Age in year group. **Children labelled with dyslexia** (Mdyslexic=6.18) **were significantly younger in their year group** compared to non-dyslexic children (Mnon-dyslexic=6.56): $t=2.09$, $p=0.04$ (12=Oldest, 1=Youngest).

Ethnicity. A significant relationship was also found between dyslexia and ethnicity: $X^2(5)=41.14$, $p<0.01$. **White cohort members were more likely to have been labelled dyslexic**, whereas **Indian, Pakistani and Bangladeshi, Black and Black British and 'other' ethnicities were less likely to have dyslexia.**

Older Sibling. There was a significant relationship between being labelled with dyslexia and having an older sibling: $X^2(1)=14.68$, $p<0.01$. **Those who had an older sibling were more likely to have dyslexia.**

Child Order. There was also a significant relationship between dyslexia and child order: $X^2(3)=22.45$, $p<0.01$. **There were more dyslexics than expected who were the youngest child and there were fewer dyslexics than expected who were the only child.**

Fee paying school. There was a significant relationship between dyslexia and attending a fee-paying school: $X^2(1)=52.62$, $p<0.01$. **Those who attended a fee-paying school were more likely to be labelled dyslexic**.

Sex. Similarly to all sweeps there was a significant relationship between dyslexia and sex: $X^2(1)=54.55$, $p<0.01$. **Males were more likely to be labelled with dyslexia than females.**

Country. There was no significant relationship found between being labelled with dyslexia and whether the cohort member lived in England or Wales: $X^2(1)=0.02$, $p=0.93$.

Summary of relationships- Dyslexic Hybrid. When the dyslexic children at age 7, 11 and 14 were combined, having a parent in the highest social class; ethnicity; age in year group; having an older sibling; child order; attending a fee-paying school; income and sex all had a significant relationship with being labelled with dyslexia.

Table 6.1 Bivariate analysis of dyslexia and categorical characteristics at ages 7, 11, 14 and Hybrid

Group	Category	Whether dyslexic (compared to not dyslexic)							
		Dyslexic age 7		Dyslexic age 11		Dyslexic age 14		Dyslexic Hybrid	
		%	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Parents highest socio-economic class	Semi-routine and routine	1.6	35	3.8	59	3.4	42	6.0	114
	Low supervisory and technical	2.4	17	3.5	13	3	13	4.2	31
	Small employers	2.1	17	3.0	32	3.3	20	5.1	54
	Intermediate	1.3	18	2.9	25	2.8	30	5.6	85
	Managerial and professional	1.9	89	4.8	84	3.7	142	**7.1**	**273**
Ethnicity	White	2.1	172	3.9	220	**3.7**	**255**	6.8	509
	Mixed	2.2	6	3.5	8	4.2	13	6.0	22
	Indian	0.8	3	1.3	*3*	*0.7*	*2*	*2.3*	*8*
	Pakistani or Bangladeshi	0	0	1	*5*	*0.1*	*1*	0.6	6
	Black or black British	0.4	2	3.3	7	2.7	8	3.8	14
	Other	1	1	1.3	2	0.7	1	*1.4*	*2*
Older sibling	No	*1.38*	*67*	*2.9*	*88*	3	135	*5.0*	*212*
	Yes	**2.3**	**121**	**4.1**	**165**	3.8	156	**6.9**	**368**
Child Order	Only child	1.5	28	*2.5*	18	2.1	32	*3.5*	*40*
	Youngest	**2.3**	**83**	**4.4**	**111**	3.9	102	**7.4**	**242**
	Middle	**2.2**	38	3.6	54	3.6	54	6.1	123
	Oldest	*1.3*	*39*	3.1	70	3.3	103	5.6	175
Fee paying school	No school fees	*1.8*	*171*	*3.3*	*201*	3.2	251	5.7	507
	School fees	**4.3**	**17**	**11.1**	**40**	7.7	40	**14.5**	**73**
Sex	Male	**2.4**	**116**	5	**160**	4.4	175	**8.1**	**356**
	Female	*1.2*	*59*	*2.3*	*82*	*2.4*	*101*	*4.3*	*193*
Country	England	1.9	151	3.5	210	3.3	235	6.1	472
	Wales	1.6	37	4.1	43	3.5	56	6.2	108

*Those in **bold** had a z score of +1.96 meaning that this category were significantly more likely to be dyslexic at the age specified, those in *italics* has a z score of -1.96 meaning that this category was significantly less likely to be dyslexic at the age specified.

Table 6.2 Bivariate analysis of dyslexia age in year at ages 7, 11, 14 and Hybrid

	Age in year group			Income			Parents' highest NVQ		
	x̄*	Std. Err	p	x̄	Std. Err	p	x̄	Std. Err	p
Not dyslexic age 7	6.58	0.04	0.7	387	5.92	0.27	3.26	0.03	0.7
Dyslexic age 7	6.48	0.26		412	22.3		3.29	0.09	
Not dyslexic age 11	6.57	0.05	0.06	418	5.5	0.23	3.32	0.03	0.2
Dyslexic age 11	6.12	0.24		432	12.8		3.44	0.01	
Not dyslexic age 14	6.55	0.04	<0.01	388	5.3	0.77	3.3	0.03	0.05
Dyslexic age 14	6.04	0.2		392	11.3		3.44	0.01	
Never labelled as dyslexic	6.56	0.05	0.04	378	5	0.11	3.22	0.03	0.1
Labelled as dyslexic in one sweep or more	6.18	0.167		392	9.6		3.32	0.06	

* 12= Oldest, 1= Youngest

6.1.5 Summary of bivariate analysis

Attending a fee-paying school and being male were consistently predictors of being labelled with dyslexia at every sweep and for the dyslexic hybrid analysis. At age 7, age 11 and dyslexic hybrid having an older sibling and child order were both significant predictors of the dyslexia label. Initial investigation into collinearity shows that these two variables are correlated with one another, therefore it is important to determine which is more important in predicting a person being labelled with dyslexia. Age in year group was significantly related to dyslexia at age 14 and the dyslexic hybrid category. Ethnicity was also found to be a significant predictor of dyslexia at age 14 and in the hybrid group. Furthermore, parents' highest NVQ level

showed a significant relationship with dyslexia at age 14. Parents' highest social class was a significant predictor of dyslexia at the hybrid level.

6.2 Logistic regression

6.2.1 Variables for inclusion in initial models

Having looked at the relationship between variables in bivariate analysis, leads to consideration of which variables should be included in the regression models. Although not every predictor variable showed a significant relationship with dyslexia at every sweep, and initial aim was to include all predictor variables in the initial models, with insignificant variables being removed individually. This is because the variable may not have been significantly related to dyslexia in bivariate analysis due to the effects of other variables. A bivariate analysis result may be insignificant due to 'noise' from other variables that strongly predict dyslexia.

However, three variables were not be included in the regression models. Firstly, school fees was not included as bivariate analysis consistently showed a highly significant relationship between school fees and dyslexia ($p<0.001$ in every sweep), however, the numbers of cohort members in the school fees cells were very small (Table 6.1). Therefore, there was a much more clustered distribution in those who attended a fee-paying school than in those who did not. As the variable was so skewed, it may supress the effects of other variables in the model. For this reason, the school fees variable was not entered into the models. However, it is important to remember its importance in its relationship with dyslexia.

Secondly, ethnicity was also excluded from the models. Whilst a significant relationship was found between ethnicity and dyslexia at age 14 and the dyslexic hybrid group, the numbers in each minority ethnic group with dyslexia were very small. Due to this, analysis of these groups could not be performed as the cell count was too low. A potential solution to this would have been to recode the variable into 'white/ non-white' as was done in Parsons and Platt (2013). However, as demonstrated in Table 6.1, at age 11, there were differences between the ethnic minorities -- those that were black or black British were not significantly less likely to have the dyslexia label, whereas those in the other ethnic minorities, were. Therefore,

recategorizing ethnicity in this binary way would disguise the differences between these ethnic minorities. For this reason, ethnicity was not included in the regression analysis. The research should be repeated in the future, when more dyslexic cohort members are identified, in order to see how membership of an ethnic minority influences the dyslexia system.

Finally, it would not make sense to include both child order and having an older sibling in the model as there was substantial overlap between the two variables, therefore it was important to determine which was the most important in predicting dyslexia. Table 6.3 shows the Wald statistic and level of significance for both child order and older sibling when both were regressed onto dyslexia together. This shows that having an older sibling was a more significant predictor of dyslexia than child order. Therefore, having an older sibling was included in the regression models and child order was excluded.

Table 6.3 Child order and older sibling regressed on dyslexia

Age	Variable	F	p
7	Child order	0.12	0.89
	Older sibling	2.6	0.11
11	Child order	1.01	0.37
	Older sibling	1.65	0.2
14	Child order	2.47	0.09
	Older sibling	4.79	0.03
Hybrid	Child order	1.33	0.25
	Older sibling	2.95	0.03

6.2.2 Logistic regression age 7

Backwards logistic regression was used in order to determine predictors of being labelled with dyslexia at age 7. The first model entered all variables, followed by the most insignificant variable being removed one by one. Table 6.4 shows the Wald statistic and the VIF for each variable in each model.

The age 7 predictors of being labelled with dyslexia were removed in the following order:

- Age in year group
- Parents highest social class
- Country
- Parents highest NVQ.

Table 6.4 Logistic regression models age 7

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	F	VIF	F	VIF	F	VIF	F	VIF	F	VIF
Ability	**100.22****	1.12	**99.68****	1.12	**101.14****	1.1	**106.99****	1.09	**107.22****	1.09
Older Sibling	**10.48****	1.01	**10.63****	1.01	**11.99****	1.0	**9.35****	1.01	**9.34****	1.01
Sex	**12.54****	1.01	**12.55****	1.01	**12.34****	1.01	**11.4****	1.08	**11.38****	1.01
Income	**6.06***	1.31	**6.15***	1.31	**5.56***	1.17	**9.38****	1.01	**9.53****	1.08
Country	**1.69**	1.00	**1.66**	1.0	**1.06**	1.0	**0.1**	1.0	-	-
NVQ	**1.19**	1.44	**1.17**	1.44	**0.59**	1.19	-	-	-	-
Social class	0.91		0.9		-	-	-	-	-	-
Low supervisory and technical		1.36		1.36	-	-	-	-	-	-
Small employers		1.47		1.47	-	-	-	-	-	-
Intermediate		1.69		1.69	-	-	-	-	-	-
Managerial and professional		2.85		2.85	-	-	-	-	-	-
Age in year	0.28	1.01			-	-	-			
Total F	**12.55****		**13.67****		**21.58****		**27.01****		**33.9****	
Mean VIF		1.39		1.43		1.08		1.04		1.05

*p<0.05, **p<0.01

The final model shows that ability, having an older sibling, sex and income were significant predictors of being labelled with dyslexia at age 7.

Table 6.5 shows the model statistics for the final model.

Table 6.5 Logistic regression age 7: Model statistics

Variable	Categories	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Ability (continuous)		0.94	0.01	-10.35	0.00	0.93	0.95
Income (continuous)		1.00	0.00	3.09	0.00	1.00	1.00
Older sibling	No older sibling (ref)						
	Older sibling	1.69	0.29	3.06	0.00	1.21	2.37
Sex	Male (ref)						
	Female	0.52	0.10	-3.37	0.00	0.36	0.76
Constant		0.14	0.04	-7.09	0.00	0.08	0.25

Ability can be interpreted as follows: when holding the other variables in the model constant, a one unit increase in ability, decreased the log-likelihood of being labelled with dyslexia by 6%. For income, a £1 increase in equivalised household income increased the likelihood of being labelled with dyslexia by 0.01%

Odds ratios for categorical variables can be converted into predicted probabilities for ease of understanding. Table 6.6 shows the predicted probabilities of being labelled with dyslexia for each group, when holding the other variables constant.

Table 6.6 Logistic regression age 7: Predicted probabilities

Variable	Categories	Margin	Std. Error	t	p	95% Confidence intervals	
Older sibling	No older sibling	**0.013**	0.02	7.46	0.00	0.01	0.02
	Older sibling	**0.022**	0.02	9.85	0.00	0.02	0.03
Sex	Male	**0.023**	0.02	10	0.00	0.02	0.03
	Female	**0.012**	0.02	6.53	0.00	0.01	0.02
Total proportion of dyslexics at age 7		**0.019**					

This can be interpreted as follows, when holding the other variables in the model constant, those with no older sibling have a 1.3% probability of being labelled with dyslexia at age 7 compared to those with an older sibling who have a 2.2% probability. This is 0.3% higher than the population average who have a 1.9% likelihood of being labelled with dyslexia. Additionally, females have a 1.2% probability of having dyslexia while males have a 2.3% probability.

6.2.3 Logistic regression age 11

The same process was applied when investigating predictors of being labelled with dyslexia at age 11. Table 6.7 shows the F statistic and VIF for each variable in the model.

The age 11 predictors of being labelled with dyslexia were removed in the following order:

- Income
- Country
- Parents' highest NVQ level

Table 6.7 Logistic regression models age 11

Variable	Model 1		Model 2		Model 3		Model 4	
	F	**VIF**	**F**	**VIF**	**F**	**VIF**	**F**	**VIF**
Ability	**34.91****	1.12	**34.35****	1.1	**34.98****	1.09	**32.39****	1.07
Older Sibling	**9.77****	1.02	**9.62****	1.01	**9.57****	1.01	**7.47****	1.01
Age in year	**8.46****	1.01	**8.46****	1.01	**8.48****	1.01	**8.33****	1.01
Sex	**23.96****		**24****	1.01	**23.95****	1.01	**21.53****	1.01
Social class	**2.05**		**2.08**		**2.05**		**3.44****	
Low supervisory and technical		1.18		1.18		1.18		1.16
Small employers		1.36		1.35		1.35		1.32
Intermediate		1.41		1.40		1.40		1.35
Managerial and professional		1.75		1.74		1.73		1.50
NVQ	**1.39**	1.8	**1.74**	1.21	**1.93**	1.21	-	-
Country	**0.6**	1.01	**0.6**	1.0	-	-	-	-
Income	**0.02**	1.5	-	-	-	-	-	-
Total F	**9.68****		**10.42****		**11.56****		**11.58****	
Mean VIF		**1.26**		**1.2**		**1.22**		**1.18**

*p<0.05 **p<0.01

The final model shows that age in year group; having an older sibling; parents' highest social class, and, sex were significant predictors of being labelled with dyslexia at age 11. Removing the insignificant variables increases the overall Wald statistic. Table 6.8 shows the odds ratios for the full model. The odds ratio for age in year can be interpreted as a one month increase in age decreased the odds of being labelled with dyslexia by 6%.

Table 6.8 Logistic regression age 11: Model statistics

Variable	Categories	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Ability	(continuous)	0.95	0.01	-5.69	0.00	0.93	0.97
Age in year	(continuous)	0.94	0.02	-2.89	0.00	0.90	0.98
Older sibling	No older sibling (ref)						
	Older sibling	1.49	0.22	2.73	0.01	1.12	1.99
Social class	Semi-routine and routine (ref)						
	Low supervisory and technical	0.95	0.33	-0.15	0.88	0.47	1.90
	Small employers	0.90	0.22	-0.45	0.65	0.55	1.45
	Intermediate	0.90	0.27	-0.37	0.71	0.50	1.61
	Managerial and professional	1.63	0.31	2.57	0.01	1.12	2.36
Sex	Male (ref)						
	Female	0.48	0.08	-4.64	0.00	0.35	0.66
Constant		0.62	0.29	-1.02	0.31	0.25	1.55

Interestingly, age in year group is consistently a significant predictor of the dyslexia label in all models despite it not being significant in initial bivariate analysis (p=0.21). Further analysis showed that age in year group became significant when controlling for parents' highest social class. Table 6.9 shows the statistics when age in year group alone was regressed on dyslexia at age 11. Table 6.10 shows the statistics when social class was then added to the model showing a significant effect of age in year group when controlling for social class.

Table 6.9 Logistic regression age 11: Age in year group regressed on dyslexia

	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Age in year	0.96	0.02	-1.84	0.07	0.92	1.00
Constant	0.05	0.01	-19.75	0.00	0.04	0.07

Table 6.10 Logistic regression age 11: Age in year group and social class regressed on dyslexia

	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Age in year	0.94	0.02	-2.74	0.01	0.91	0.98
Semi-routine and routine (ref)						
Low supervisory and technical	0.90	0.32	-0.30	0.76	0.45	1.79
Small employers	0.82	0.20	-0.84	0.40	0.51	1.31
Intermediate	0.74	0.22	-1.02	0.31	0.41	1.33
Managerial and professional	1.29	0.23	1.40	0.16	0.90	1.84
Constant	0.06	0.01	-13.61	0.00	0.04	0.09

This suggests that there was some interaction between age in year group and social class whereby, when comparing children of the same social class there was an effect of age in year group, which was not significant when social class was not taken into account. However, when the interaction term was added to the model the interaction term was insignificant. Nevertheless, Gomm (2009) states that "interaction occurs when the association between two variables is affected by a third variable" (p. 176). In this case, the association between the dyslexia label and the child's age in their year group was affected by social class.

Additionally, social class was not a predictor of dyslexia in bivariate analysis. Therefore, it is interesting to investigate why social class was a significant predictor of the dyslexia label in the final regression model. Social class becomes a significant predictor of dyslexia when controlling for ability. Table 6.11 and Table 6.12 show that social class was not a significant predictor when regressed on dyslexia alone, however, when ability was included in the model, those in the managerial and professional class were significantly more likely to have the label of dyslexia than those in the semi-routine and routine class.

Table 6.11 Logistic regression age 11: Parents' highest social class regressed on dyslexia

	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Semi-routine and routine (ref)						
Low supervisory and technical	0.92	0.30	-0.24	0.81	0.48	1.77
Small employers	0.80	0.19	-0.98	0.33	0.50	1.26
Intermediate	0.75	0.21	-1.02	0.31	0.43	1.31
Managerial and professional	1.28	0.22	1.44	0.15	0.91	1.80
Constant	0.04	0.01	-22.45	0.00	0.03	0.05

Table 6.12 Logistic regression age 11: Parents' highest social class and ability regressed on dyslexia

	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Ability	0.95	0.01	-6.51	0.00	0.93	0.96
Semi-routine and routine (ref)						
Low supervisory and technical	0.97	0.32	-0.09	0.93	0.50	1.87
Small employers	0.87	0.21	-0.59	0.55	0.55	1.38
Intermediate	0.89	0.25	-0.39	0.70	0.51	1.57
Managerial and professional	1.58	0.29	2.51	0.01	1.10	2.27
Constant	0.43	0.16	-2.28	0.02	0.21	0.89

Categorical variables in the final model can also be converted into predicted probabilities using the margins command in Stata. Table 6.13 shows the predicted probability of having the dyslexia label for each group, when holding the other variables in the model constant.

Table 6.13 Logistic regression age 11: Predicted probabilities

Variable	Category	Margin	Std. Err.	t	p	95% Conf. Interval	
Older sibling	No older sibling	**0.031**	0.00	8.71	0.00	0.02	0.04
	Older sibling	**0.046**	0.00	10.45	0.00	0.04	0.05
Social class	Semi-routine and routine	**0.035**	0.01	7.05	0.00	0.03	0.05
	Low supervisory and technical	**0.034**	0.01	3.36	0.00	0.01	0.05
	Small employers	**0.032**	0.01	5.02	0.00	0.02	0.04
	Intermediate	**0.032**	0.01	4.37	0.00	0.02	0.05
	Managerial and professional	**0.056**	0.01	8.95	0.00	0.04	0.07
Sex	Male	**0.052**	0.00	10.47	0.00	0.04	0.06
	Female	**0.026**	0.00	7.95	0.00	0.02	0.03
Total proportion of dyslexics at age 11		**0.036**					

This can be interpreted as, at age 11, those who had an older sibling had a 4.6% probability of being labelled with dyslexia, compared to those with no older sibling who had a 3.1% probability of being labelled with dyslexia. As 3.6% of the sample population had the dyslexic label those who had an older sibling are 1% more likely to have been labelled with dyslexia than the sample population. Of interest, those whose parents' highest social class was 'managerial and professional' were much more likely to have been labelled with dyslexia at age 11. These children were 2% more likely to have dyslexia than the population average.

6.2.4 Logistic regression age 14

The same process was repeated for age 14. Table 6.14 shows the F statistic and VIF for each variable in the model. The insignificant predictors of being labelled with dyslexia at age 14 were removed in the following order:

- Parents' highest social class
- Country
- Income
- Older sibling

Table 6.14 Logistic regression age 14 models

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	F	VIF	F	VIF	F	VIF	F	VIF	F	VIF
Ability	**50.85****	1.12	**51.96****	1.13	**52.27****	1.13	**53.16****	1.08	**56.96****	1.07
Age in year	**7.2****	1.01	**5.6***	1.01	**5.61****	1.01	**5.47****	1.0	**5.67****	1.0
Sex	**16.36****	1.01	**20.59****	1.01	**20.72****	1.01	**20.77****	1.01	**21.06****	1.01
NVQ	**0.52**	1.4	**5.7***	1.26	**5.66***	1.26	**9.83**	1.06	**9.83****	1.06
Older sibling	**5.6***	1.02	**2.64**	1.01	**2.63**	1.01	**2.5**	1.01	-	-
Income	**0.37**	1.29	**0.34**	1.3	**0.31**	1.30	-	-	-	-
Country	**1.64**	1.0	**0.93**	1.0	-	-	-	-	-	-
Social class	**0.62**		-	-	-	-	-	-	-	-
Low supervisory and technical		1.26	-	-	-	-	-	-	-	-
Small employers		1.55	-	-	-	-	-	-	-	-
Intermediate		1.8	-	-	-	-	-	-	-	-
Managerial and professional		2.75	-	-	-	-	-	-	-	-
Total F	**8.06****		**13.14****		**15.24****		**18.29****		**22.03****	
Mean VIF		1.38		1.1		1.12		1.03		1.04

*p<0.05 **p<0.01

Table 6.14 shows that significant predictors of dyslexia at age 14 were age in year group, sex and parents' highest education level. Table 6.15 shows the full model.

Table 6.15 Logistic regression age 14: Model statistics

Variable	Category	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Ability (continuous)		0.95	0.01	-7.55	0.00	0.94	0.96
Age in year (continuous)		0.96	0.02	-2.38	0.02	0.92	0.99
Parents highest NVQ (continuous)		1.18	0.06	3.14	0.00	1.06	1.31
Sex	Male (ref)						
	Female	0.54	0.07	-4.59	0.00	0.41	0.70
Constant		0.32	0.12	-3.14	0.00	0.16	0.65

Age in year can be interpreted as, at age 14, a one month increase in age decreased the odds of being labelled dyslexic by 5%. Whilst a one unit increase in parents' education level increased the odds of the dyslexia label by 1.8%.

6.2.5 Logistic regression dyslexic hybrid

Finally, the process was repeated for the dyslexic hybrid group. This was the group that had been labelled as dyslexic in any of the three sweeps. The predictor variables were calculated using the mode or median over the three sweeps. Table 6.16 shows the Wald statistic and VIF for each model. The insignificant variables were removed in the following order:

- Country
- Parents highest NVQ

Table 6.16 Logistic regression models dyslexic hybrid

	Model 1		Model 2		Model 3	
	F	**VIF**	**F**	**VIF**	**F**	**VIF**
Ability	**85.42****	1.15	**85.48****	1.15	**58.27****	1.17
Age in Year	**6.93****	1.00	**6.9****	1.00	**6.88****	1.00
Income	**2.14**	1.70	**2.23**	1.69	**5.57***	1.58
Older Sibling	**36.15****	1.02	**14.35****	1.02	**13.63****	1.02
Sex	**29.58****	1.01	**36.19****	1.01	**32.92****	1.01
Social class	**2.13**		**2.13**		**2.77***	
Low supervisory and technical		1.29		1.29		1.25
Small employers		1.48		1.48		1.41
Intermediate		1.68		1.68		1.57
Managerial and professional		2.73		2.73		2.43
NVQ	**1.31**	1.53	1.18	1.53	-	-
Country	**0.22**	1.01	-	-	-	-
Total F	**12.69****		**12.76****		**12.83****	
Mean VIF		1.42		1.46		1.38

Table 6.16 shows that age in year, equivalised household income, having an older sibling, sex and social class were all significant predictors of being labelled with dyslexia at age 7, 11 or 14. Table 6.17 shows the final model statistics.

Table 6.17 Logistic regression dyslexic hybrid: Model statistics

Variable	Category	Odds Ratio	Std. Err.	t	p	95% Conf. Interval	
Ability (continuous)		0.95	0.01	-7.63	0.00	0.94	0.97
Age in year (continuous)		0.96	0.01	-2.62	0.01	0.93	0.99
Income (continuous)		1.00	0.00	2.36	0.02	1.00	1.00
Older sibling	No older sibling (ref)						
	Older sibling	1.50	0.17	3.69	0.00	1.21	1.87
Sex	Male (ref)						
	Female	0.54	0.06	-5.74	0.00	0.43	0.66
Parents highest social class	Semi-routine and routine (ref)						
	Low supervisory and technical	0.71	0.18	-1.35	0.18	0.43	1.17
	Small employers	0.86	0.17	-0.75	0.45	0.58	1.27
	Intermediate	1.09	0.22	0.43	0.67	0.74	1.61
	Managerial and professional	1.33	0.23	1.65	0.10	0.95	1.87
Constant		0.43	0.12	-2.99	0.00	0.24	0.75

Age in year can be interpreted as, when holding the other variables constant, a one month increase in age decreased the log-odds of being labelled with dyslexia at age 7, 11 or 14 by 4%.

Income can be interpreted in the same way: a £1 increase in equivelised weekly family income, increased the log-odds of being labelled with dyslexia at age 7, 11 or 14 by 0.01%. Table 6.18 shows the predicted probabilities of being labelled dyslexic for the categorical variables.

Table 6.18 Logistic regression dyslexic hybrid: Predicted probabilities

Variable	Category	Margin	Std. Err.	t	p	95% Conf. Interval	
Older sibling	No older sibling	**0.050**	0.00	11.23	0.00	0.04	0.06
	Older sibling	**0.073**	0.00	15.53	0.00	0.06	0.08
Parents highest social class	Semi-routine and routine	**0.058**	0.01	8.08	0.00	0.04	0.07
	Low supervisory and technical	**0.042**	0.01	4.95	0.00	0.03	0.06
	Small employers	**0.051**	0.01	6.33	0.00	0.03	0.07
	Intermediate	**0.063**	0.01	7.49	0.00	0.05	0.08
	Managerial and professional	**0.076**	0.01	12.47	0.00	0.06	0.09
Sex	Male	**0.080**	0.01	15.21	0.00	0.07	0.09
	Female	**0.045**	0.00	11.60	0.00	0.04	0.05
Total proportion of dyslexics		**0.061**					

We can interpret these as, when holding the other variables in the model constant, those who had an older sibling had a 7.3% probability of being labelled with dyslexia. This is higher than those who did not have an older sibling who had a 5% probability of being labelled with dyslexia.

6.3 Propensity score matching (PSM)

The dyslexic hybrid group was then used to investigate whether there was a significant difference in those labelled with dyslexia and a matched group. The method used for PSM is outlined in the Section 5.2.3.

6.3.1 Academic self-concept

English. Prior to matching, in the whole sample there was a significant difference between those who were labelled as dyslexic and those who were not in how they responded to the question "I am good at English" (Table 6.19). Those that had been labelled with dyslexia were less likely to agree that they were good at English compared to those who were not labelled. It would be expected that the difference between those that were labelled dyslexic and those that were not would fall once the groups were matched.

However, after matching the groups using nearest neighbourhood matching (without replacement) there remained a significant difference between the dyslexic group and the non-dyslexic control group. The results from this analysis show that the dyslexic group held a significantly lower opinion on their ability in English than their matched peers that did not hold this label, but who shared the same likelihood of being labelled with dyslexia. Figure 6.1 shows the difference between the groups.

Table 6.19 Propensity score matching- "I am good at English" (4- Strongly agree, 1- Strongly disagree)

	Dyslexic average	Non-dyslexic average	Difference	Std. Err.	T-stat
Unmatched	2.63	3.06	-0.42	0.03	-12.73
Nearest Neighbour matching	2.63	3.01	-0.37	0.05*	-7.9

* Adjusted using Abadie and Imbens (2006)

Figure 6.1 "I am good at English"
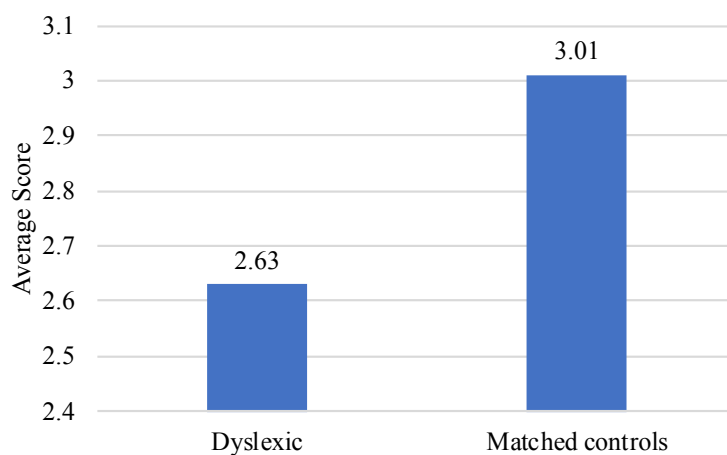
Maths. Prior to matching there was a significant difference between those that were labelled dyslexic, and those that were not, in their response to the statement "I am good at maths" (Table 6.20). While this was a smaller effect than for the statement "I am good at English" it was still a significant difference. After matching, while the difference decreased there remained a significant difference between those who had been labelled dyslexic and

their matched peers. Figure 6.2 shows the difference in average scores between the dyslexic and matched groups.

Table 6.20 Propensity score matching- "I am good at maths" (4- Strongly agree, 1- Strongly disagree)

	Dyslexic average	Non-dyslexic average	Difference	Std. Err.	T-stat
Unmatched	2.80	3.04	-0.23	0.04	-6.15
Nearest Neighbour matching	2.80	2.96	-0.15	0.05*	-2.95

* Adjusted using Abadie and Imbens (2006)

Figure 6.2 "I am good at maths"
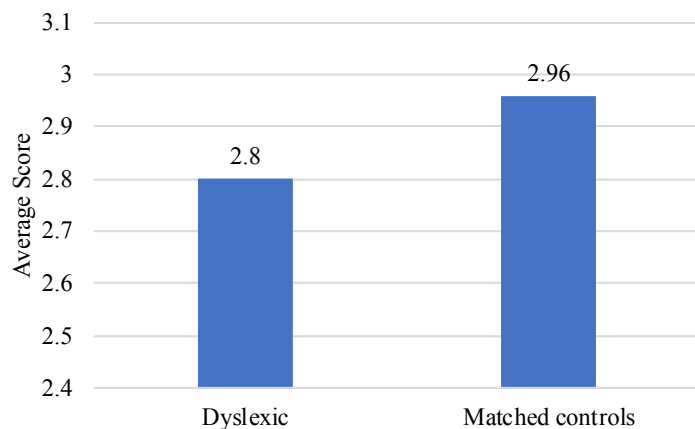
Science. Table 6.21 shows that there was a significant difference between those labelled dyslexic and those without the dyslexia label in their response to the statement "I am good at science". This difference was not as large once matching the groups. However, the significant result shows that, similarly to the results for maths and English, those with dyslexia showed a significantly lower academic self-concept in science than their matched peers. Figure 6.3 shows the difference between the groups.

Table 6.21 Propensity score matching- "I am good at science" (4- Strongly agree, 1- Strongly disagree)

	Dyslexic average	Non-dyslexic average	Difference	Std. Err.	T-stat
Unmatched	2.91	3.02	-0.12	0.04	-3.2
Nearest Neighbour matching	2.91	2.99	-0.08	0.03*	-2.91

* Adjusted using Abadie and Imbens (2006)

Figure 6.3 "I am good at science"
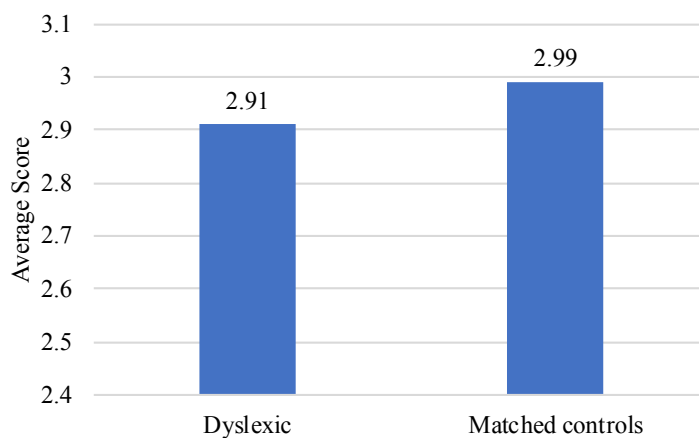
Physical education (PE). However, Table 6.22 shows that no-significant difference was found between how the cohort members viewed their ability in PE.

Table 6.22 "I am good at PE"

	Dyslexic average	Non-dyslexic average	Difference	Std. Err.	T-stat
Unmatched	3.07	3.01	0.07	0.04	1.50
Nearest Neighbour matching	3.07	3.04	0.03	0.06*	0.43

* Adjusted using Abadie and Imbens (2006)

6.3.2 Likelihood of going to university

Children. Table 6.23 shows that before matching the groups, there was a largely significant difference in how those labelled dyslexic rated their likelihood of going to university compared to non-dyslexic peers. This remained significant once matching the cohort members. Figure 6.4 shows the average scores for the dyslexics and the matched controls.

Table 6.23 Propensity score matching "How likely do you think it is that you will go to university?" (Scale from 0 to 100)

	Dyslexic average	**Non-dyslexic average**	**Difference**	**Std. Err.**	**T-stat**
Unmatched	59.87	70.81	-10.93	1.38	-7.87
Nearest Neighbour matching	59.87	68.45	-8.58	1.97*	-4.35

* Adjusted using Abadie and Imbens (2006)

Figure 6.4 "How likely do you think it is that you will go to university?"
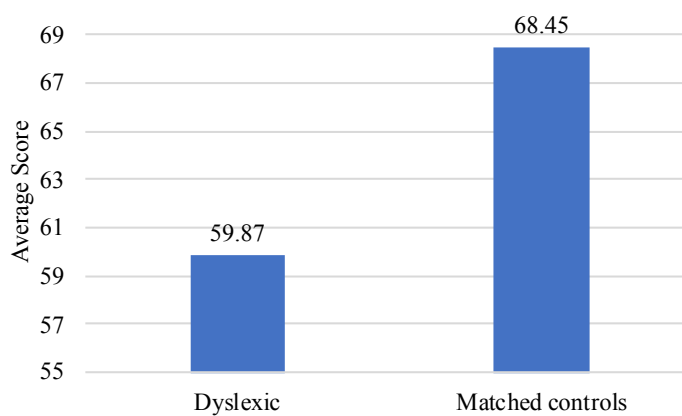
Parents. There was also a significant effect of the dyslexia label on how the parents rated the child's likelihood of going to university (Table 6.24). Before matching the groups, there was a large difference between the dyslexic and non-dyslexic group in the average likelihood that their parents gave them on going to university. This remained significant when the groups were matched. Figure 6.5 shows the parents average scores for the dyslexics and the matched controls.

Table 6.24 Propensity score matching "How likely is it that child will go to university?" (4- very likely, 1- not likely at all) (Parents)

	Dyslexic average	**Non-dyslexic average**	**Difference**	**Std. Err.**	**T-stat**
Unmatched	2.82	2.23	-0.5	0.04	-12.21
Nearest Neighbour matching	2.82	3.25	-0.42	0.06*	-7.08

* Adjusted using Abadie and Imbens (2006)

Figure 6.5 "How likely is it that child will go to university?" (Parents)
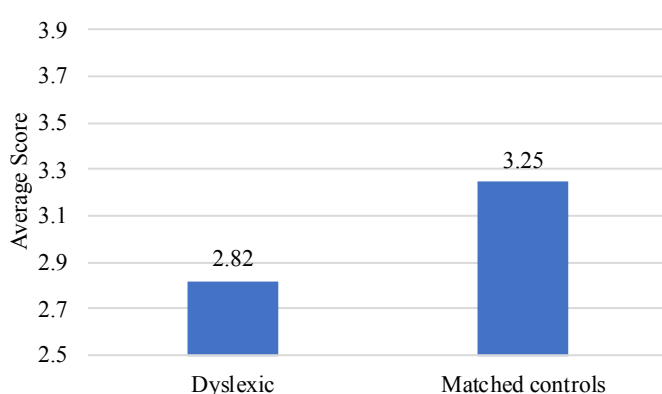
Teachers. The child's teacher was also asked about the likelihood that the child will go to university. As the teachers were not questioned during the age 14 survey, these results came from data up to age 11 only. The results showed that there was a significant difference for the unmatched groups, whereby, on average, the teachers believed that the dyslexic children would be less likely to go to university than the non-dyslexic children (Table 6.25). This difference remained significant once the groups were matched (Figure 6.6).

Table 6.25 Propensity score matching "How likely is it that child will go to university?" (4- very likely, 1- not likely at all) (teachers)

	Dyslexic average	**Non-dyslexic average**	**Difference**	**Std. Err.**	**T-stat**
Unmatched	2.34	3.07	-0.73	0.06	-12.82
Nearest Neighbour matching	2.34	2.88	-0.54	0.08*	-6.9

* Adjusted using Abadie and Imbens, 2006

Figure 6.6 Radius matching "How likely is it that child will go to university?" (Teachers)
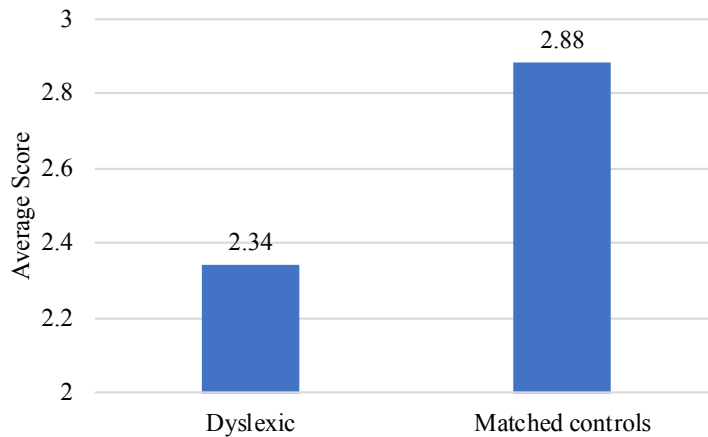
6.3.3 Summary of PSM analysis

PSM showed that in children matched on ability; income; older sibling; sex; parents' highest social class; parents highest education level and age in year group, those labelled with dyslexia had lower academic self-concept and lower expectations about going to university than those without the dyslexia label. Furthermore, parents and teachers also had lower expectations that the child would go to university compared to the non-dyslexic children.

CHAPTER 7

Millennium Cohort Study - Discussion

7 | Millennium Cohort Study - Discussion

This chapter will discuss the results that specifically arose from the analysis of the Millennium Cohort Study (MCS) data. I will firstly discuss the findings in accordance with the predetermined research questions, before addressing the potential limitations of the MCS research. *Chapter 11: Concluding Discussion* will follow the discussion of the teacher survey and will bring together the overall conclusions from both studies.

7.1 Findings relating to research questions

7.1.1 What individual level aspects influence the probability of the dyslexia label? (RQ1)

While the data available did not allow investigation into predictors of a formal dyslexia diagnosis, they allowed investigation into predictors of an individual having the dyslexia label (attributed either by their parent or teacher). A consistent significant individual level predictor of the dyslexia label was being male. Age in year group was also a significant predictor of having dyslexia at age 11, 14 and at the hybrid level. Those who were younger in their year group were more likely to be labelled with dyslexia than those who were older in their year group. I will now discuss each of these individual level predictors of dyslexia and explore what this may tell us about the process of dyslexia labelling.

Age. Firstly, the age of the child impacted the significant predictors of being considered dyslexic. There were fewer factors that impacted the label at age 7 compared to at age 11 and 14. While the current research cannot shed light as to why this is the case I theorise the following: those labelled with dyslexia at a younger age have larger difficulties relating to their dyslexia, and therefore, the dyslexia is more obvious and interaction with environmental factors is not needed in order for the dyslexia to be recognised. Those labelled later may show lesser difficulties and, therefore, interactions with the environment cause the label to emerge. Further research is required to examine this hypothesis further.

Sex. A significant individual predictor of being labelled with dyslexia at all ages was being male. Previous research suggests that due to biological and cognitive factors alone, the ratio of males to females should be 1.15:1 (Arnett et al. 2017). Results from this study suggest that, when holding the other variables in the model constant, the ratio of males to female is approximately 2:1 at age 7; 2:1 at age 11; and, 1.5:1 at age 14. Therefore, at all ages, there appears to be an overrepresentation of males, that cannot be explained by the biological factors suggested by Arnett et al. (2017) alone. This suggests that there may be some social determinants that are also involved in why males are more likely to be labelled as dyslexic compared to females.

As previously discussed, Shaywitz (1996) suggests that the reason more boys than girls receive a label of dyslexia is that girls demand less attention in the classroom and, therefore, boys are more readily bought to the attention of teachers. On the other hand, Peterson and Pennington (2012) suggest that the reason for the over referral of boys is that "boys with dyslexia come to clinical attention more often than girls, simply because they have higher rates of comorbid externalising disorders, including attention deficit hyperactivity disorder (ADHD)" (p.1,997). This would suggest a biological predeterminate of the differences in diagnostic rates between boys and girls. Further research should investigate this complex interaction between the biological and social factors associated with sex and how they may result in an overrepresentation of male dyslexics.

Age in year group. Other than at age 7, it was consistently found that those who were younger in their year group were more likely to be labelled with dyslexia than those who were older in their year group. This result supports other research into SENs which has also found that those who are younger in their year are more likely to have a special educational need (SEN) (Anders et al., 2011; Crawford, Dearden & Greaves, 2004; Zoega, Valdimarsdóttir & Hernández-Díaz, 2012). As there is no neurobiological reason as to why those that are younger would be more likely to have dyslexia, this again suggests that social demographic factors are impacting the labelling process. A possible reason is that due to being younger in the

year an individual may be underperforming in comparison to their peers and a dyslexia label is sought.

7.1.2 What other aspects within the dyslexic individual's environment may also influence the probability of the dyslexia label? (RQ2)

In addition to the individual level aspects discussed above, aspects in the individual's environment also influence whether or not a child is labelled with dyslexia. Firstly, attending a fee-paying school was such a strong predictor of dyslexia that it could not be included in the models. This was correlated with income and social-class and so the implications of this will be discussed in this context below. Having an older sibling was a significant predictor of dyslexia at ages 7, 11 and in the hybrid group. Furthermore, the parents' socioeconomic class was not only a predictor of dyslexia at age 11 and in the hybrid group, but also influenced the relationship between age in year group and dyslexia at age 11. Equivelised weekly family income was also a significant predictor of being labelled with dyslexia at age 7 and during the dyslexia hybrid analysis. Furthermore, parents' education level was a significant predictor of dyslexia at age 14. Each of these variables will now be discussed.

Older sibling. Having older sibling was a significant predictor of being labelled with dyslexia at ages 7, 11 and at the hybrid level. While previous research has shown the importance of siblingship on academic outcomes (Bagger et al. 2013; Behrman & Taubamn, 1986; Booth & Kee, 2009; Black et al. 2005; Hotz & Pantano, 2013; Iacovou, 2008; Kantarevic & Mechoulan, 2005; Kirsten & Bjerkedal, 2010), to my knowledge, this is the first research that has shown the impact of having an older sibling on being considered dyslexic. Therefore, further work needs to be done to ascertain why this may be the case; I suggest three possible explanations. The first is that the younger sibling may be directly comparable to the older. Consequently, parents, and others, may compare the siblings and find that the younger is not performing at the same standard as the older child was at the same age, resulting in the parents seeking a diagnosis and consequently obtaining the dyslexia label. Secondly, as it is not possible to determine

from the MCS whether or not the older sibling has a SEN, the older sibling may already be diagnosed and, as dyslexia is said to be in some way heritable, a diagnosis will be sought for the younger child. Finally, another possible attributing factor could be that parents of a second child are more experienced having already negotiated the school system with the older child. This knowledge may situate them as more prepared to interact with school staff and request testing and action in relation to their child's progression.

It was interesting to note that child order was not a significant predictor the dyslexia label when having an older sibling was included in the model. Therefore, attributes that may be associated with being the youngest child, for example, would not be sufficient explanations for this finding. It is likely that the relationship between having an older sibling and having dyslexia is complex, further work should be done in this area to disentangle these relationships.

Socioeconomic class structures. Parents' highest social class was also found to be a significant predictor of being labelled with dyslexia at age 11 and overall in the hybrid group. This effect was largely driven by the 'managerial and professional' group. Therefore, whilst studies into SEN more generally have found that it is those in the lower SECs that tend to have a SEN (Anders et al., 2011; Croll, 2002; Blackburn, Spencer, & Read, 2010; Parsons & Platt, 2013; Parsons & Platt, 2017), in the case of dyslexia, the opposite was found. Unfortunately, it is not possible to determine how the child studied gained the dyslexia label, however it is plausible to suggest that those within this higher social class would have been more able to seek out and pay for a diagnosis than those in other social classes. However, at age 11 it is interesting to note that parents' highest social class was a significant predictor the dyslexia while income was not. Furthermore, at the hybrid level both income and social class were significant predictors of the dyslexia label, showing that social class is significant even when controlling for income. Therefore, it does not seem to be a case of being able to afford the diagnosis and subsequent label, but rather, factors associated with social class that are most important in the child receiving a label.

In his work with black middle class parents Gilborn (2015) suggested that both the economic capabilities of the middle class, and their "cultural and social capital (often using friendship and professional networks to help negotiate the system)" (p.208) aided them in getting a SEN diagnosis for their child. As socioeconomic class was found to be a more important predictor of the dyslexia label than income, the findings from this research suggest that the cultural and social capital of the middle class is more important than the economic capital. Therefore, it is interesting to question what social and cultural capital the highest socio-economic class has which means that they are more likely to have a child labelled with dyslexia. As discussed in Section 3.5.6 Reay, Crozier and James (2011) suggest that a key value for the middle class is "educational excellence" (p.12). It could be hypothesised that this drive for educational excellence, combined with economic, social and cultural capital, means that the highest social class is able to manipulate their circumstances to ensure that their children get the help that they need. Furthermore, gaining a label of dyslexia, may give the parents a reason for why their child is not showing the 'educational excellence' that they value. This raises some questions about fairness of access to the resources that are available to dyslexic students. Particularly, in the age groups studied, the allocation of extra time in examinations.

Thus, the findings from this study not only show that social class is linked with dyslexia labelling but can allow insight into one of the many ways that social class structures may be being reinforced in current society. As those with the dyslexia label will have access to extra time in examinations this will arguably give them an advantage in exams in comparison to similar ability peers who do not have extra time. As economic and cultural capital appears to be a factor in dyslexia labelling, those that receive this advantage in exanimations are likely to be from a more advantaged background. Consequently, providing this service to those in the highest social class, leaves those from less advantaged backgrounds without access to this additional support. Thus, this could be seen as a contributing factor in widening the education gap between the higher and lower social classes.

While social class predicted the dyslexia label at ages 11 and at any age, parents' education level was a significant predictor of dyslexia at age 14. As parents' education level increased, so did the likelihood of the cohort member being labelled with dyslexia. Furthermore, at ages 7 and in the hybrid group, income was a significant predictor of dyslexia. As equivalised household income increased, so did the likelihood of being labelled with dyslexia. These factors, combined with the impact of social class, demonstrate the impact of social, cultural and economic capital on the dyslexia label. This raises clear questions about the fairness of allocation of resources to those labelled with dyslexia.

7.1.3 How does the dyslexia label impact academic self-concept? (RQ3)

Propensity score matching was used to investigate the impact of the dyslexia label on academic self-concept in two groups matched on the aforementioned predictors of dyslexia. As discussed in Section 3.1 there are mixed findings on the relationship between the dyslexia label and academic self-concept. In studies that aim to isolate the label of dyslexia (such as the current research) a negative impact of the dyslexia label is shown (Polychroni, Koukoura and Anagnostou, 2006; Riddick et al. 1999). Yet, results from semi-structured interview studies call for early diagnosis due to the positive impact that their participants reported (Glazzard, 2010; Ingesson, 2007; Leitão et al., 2017). Results from the current study show that those labelled with dyslexia were significantly less likely to agree that they were good at English, maths and science than their matched peers. Results showed that prior to matching the participants there was a large difference between the two groups on all measures (apart from for PE). Once the participants were matched, although the size of the differences fell, they remained significant. This suggest that while the matching characteristics (ability, sex, older sibling, parent's highest socio-economic class, parent's highest education level, income and age in year group) accounted for some of the difference between the groups, the difference of being labelled dyslexic still had a significant influence on the outcome. Therefore, research that has suggested that being academically low-achieving is the likely cause of low feelings of self-worth in dyslexia

individuals appears to be misinformed (Alesi, Rappo & Pepi, 2012; Eissa, 2010; Ingession, 2007; Glazzard, 2010; Leitão et al. 2017). The current results show that non-dyslexics with matched ability to the dyslexic individuals had higher levels of academic self-concept despite being matched on general ability levels. Furthermore, aspects such a sex and social-class have also been found to be correlated with academic self-concept (Cokley, 2002; Marsh & Yeung, 1998; Rimkute et al., 2014; Rogers, Smith & Coleman, 1978; Trautwein, Lüdtke, Marsh & Nagy, 2009). Matching on these characteristics also meant that the lower academic self-concept found in those with dyslexia was also not impacted by these factors.

The most common trait endorsed by those who diagnose dyslexia, is that it is associated with 'current literacy skills difficulties' (Ryder & Norwich, 2018), therefore, it may be expected that those labelled with dyslexia rate themselves less positively in English. However, interestingly both maths and science were also significantly negatively affected by the dyslexia label. This is despite maths and science skills not being directly associated with dyslexia. This therefore, suggests that the dyslexia label does not just impact an individual's attitude towards their literacy ability, but also towards their academic ability more broadly. As PE was not negatively affected by the dyslexia label, it can be hypothesized this this affect is limited to 'academic subjects', as opposed to school subjects more broadly.

These results dispute the conclusions of previous research which has called for early diagnosis and subsequent labelling by highlighting the benefits of the label for the individual (Ingesson, 2007; Glazzard, 2010; Leitão et al., 2017). This study shows a clear negative impact of the label on the academic self-concept of the participants at age 14.

7.1.4 How does the dyslexia label impact aspirations? (RQ4)

In addition to the dyslexia label being found to negatively impact academic self-concept, it was also found to negatively impact educational aspirations. Those with dyslexia were significantly less likely to say that they would go to university in the future when compared to matched peers. Similarly, to academic self-concept, aspects that may influence the likelihood of an

individual going to university (such as socioeconomic class) were used to match the participants. Therefore, this was a significant difference despite these aspects being controlled for. This finding differs from that of Rimkute et al. (2014) who found that those with dyslexia had lower expectations than those without dyslexia, however, once academic achievement had been controlled for, this relationship was no-longer significant. In this case, the expectations of dyslexic cohort members were still significantly lower than the non-dyslexic cohort members once controlling for ability. However, in this study general ability is being used as a proxy for academic ability (to be discussed in Section 7.2).

7.1.5 How does the dyslexia label impact the aspirations of teachers and parents? (RQ5)

Not only did those labelled dyslexic hold lower expectations about their likelihood of going to university, the parents and teachers of the labelled individuals also held significantly lower expectations for this group. Once again, this was despite matching on the significant predictors of dyslexia. Discussed in Section 3.3 was how important teachers may be in a child's development. Bronfenbrenner (1979) discussed the proximal processes that may take place between teacher, parent and child in shaping the development of the individual in the micro-system. Furthermore, theories and research into teacher expectancy show that a teacher's expectations may shape the outcomes of the child (Babad, Inbar and Rosenthal, 1982; Brophy, 1983; Friedrich et al., 2014; Hornstra et al., 2010; Merton, 1948; Rosental & Jacobson, 1968; Urhahne et al., 2011; Zhu, Urhahne & Rubie-Davies, 2017). The current results suggest that teachers hold lower expectations of the dyslexic child's academic ability while holding higher expectations of those with matched characteristics who do not have the dyslexia label. Therefore, suggesting that the label is impacting these expectations. Thus, it is important to question what teachers understand about the label of dyslexia and how this may impact their expectations of the dyslexic child. The following research will explore this question further.

7.2 Limitations of the Millennium Cohort Study analysis

There are some limitations to looking at dyslexia in this way. Firstly, while this study has indicated a number of interesting and relevant factors that are associated with the dyslexia label at different ages in England and in Wales, it is only possible to speculate about how these aspects lead to dyslexia labelling. Therefore, much more work is needed looking at exactly how these elements interact to result in the dyslexia label.

Secondly, a key limitation of the current data is that those identified as dyslexic at age 7 or 11, were not necessarily labelled as dyslexic at age 14. One reason for this may be due to the fact that different people were questioned on the child's dyslexia in different sweeps. While this is an interesting finding as it shows that teachers and parents do not have the same understanding of a child's special educational needs (SEN), it means that there may be some inaccuracies in this data as those in the non-dyslexic reference group may also have been labelled as dyslexic, but it was not defined at that age.

Furthermore, as the reporting of dyslexia is not objective (i.e. we are not aware if the child has an official diagnosis of dyslexia) it could be argued that how the parent or teacher answered the question about dyslexia could be influenced by some of the factors that it was found to be predicted by. For example, parents from the higher social class may simply prefer to use the term dyslexia instead of another SEN category.

However, comparisons with the NPD showed that those who were identified as dyslexic were also likely to be on the SEN register. Therefore, suggesting some validity in the reporting of dyslexia.

Lack of consensus about the label also meant that more sophisticated longitudinal research that could explore the effect of age, could not be conducted as it was not possible to follow the same dyslexic group throughout the sweeps. Furthermore, the analysis is cross sectional as the same group could not be identified as dyslexic in each sweep. Therefore, the analysis investigates correlates of the dyslexia label on different samples of children who were identified with dyslexia at each of the three ages considered. As a result, it is not possible to make developmental conclusions about the labelling of dyslexia at different ages. However, the

MCS offers a large sample to longitudinally study children in the UK; few other datasets provide this potential. Therefore, while there may be limitations with regards to continuity of questions, using the MCS is arguably the best way to answer the central research questions set out in this thesis.

Furthermore, the study uses a general ability measure to indicate the individuals' ability. It may have been more worthwhile to use the cohort member's actual academic outcomes. However, as outlined in Section 5.1.4, it was not possible to conduct this analysis with the National Pupil Database (NPD) data due to the limited nature of this dataset. However, with the data that was available it was possible to show a correlation between ability and KS2 outcomes in England. Yet, it cannot be assumed that these are the same thing. Therefore, while conclusions can be drawn about how general ability contributes to the dyslexia label, it is not possible to draw conclusions on the impact of actual academic achievement on dyslexic labelling, however it could be hypothesised that there would be a similar relationship.

Furthermore, for this reason, the PSM matches the dyslexic cohort members on general ability and not on academic outcomes. Therefore, while the comparisons can be made between two groups of a similar general ability, they are not matched on academic outcomes. Thus, while significant differences are found between the dyslexic and non-dyslexics on academic self-concept, it cannot be ruled out that this is not the result of genuine lower performance in academia in the dyslexic group. However, as stated, there is a correlation between the general ability measure used, and academic outcomes.

A final limitation of the PSM results is that while the variables used to match the groups had been found predict the dyslexia label, other variables that are unmeasured in this dataset may also predict dyslexia. Therefore, while caution has been taken to the fullest extent possible, it is difficult to conclude that the significant differences between the dyslexics and non-dyslexics are due to a labelling effect alone. Other variables that may correlate with dyslexia, that could not be controlled for in PSM could be causing these differences.

CHAPTER 8

Teacher Survey - Methods

8 | Teacher Survey – Methods

This chapter will now move away from the Millennium Cohort Study (MCS) analysis to look at the collection of data on teachers' opinions and experiences with dyslexia.

8.1 Online surveys

Prior to discussing the decisions that were made in designing and issuing the survey, it is important to situate the online survey in the broader context of survey research.

Traditionally surveys have been conducted via telephone or in person when an interviewer records the participants responses, or, via self-administered surveys where the respondent selects their responses on a paper-based questionnaire. However, in the last few decades the evolution of the internet has revolutionised the way in which survey data can be collected. This new era of survey research has allowed surveys to be available to the masses and at lower costs than previous data collection methods. Online surveys are self-administered by the respondent online and this therefore "puts the tool in the hands of almost every person with access to the internet" (Couper, 2000, p.465). Hence, whereas previously large-scale data collection was time-consuming and expensive, and therefore, restricted to those who had the necessary resources to dedicate to the data collection (e.g. governments and large corporations), large scale data can now be collected from the masses "potentially fully democratizing the survey-taking process" (Couper, 2000, p.465).

However, it is also important to note that while there are many benefits to the online survey method of data collection, there are also disadvantages which need to be considered before, during and after the data collection. An often-mentioned disadvantage is that not everyone has access to the internet. In 2016, when the data were collected, 89% of households in Great Britain had access to the internet (ONS, 2016), potentially meaning that 11% of the population could not be contacted. However, as the survey was sent to school email addresses, all of the schools in England had an associated email address, suggesting that all English schools had access to

the internet. In Wales, only one school did not have an email address and therefore, was not contacted. This suggests that, as it was schools that were contacted, and emails were not sent to households, almost all of the teaching population could be reached via their school's email address, highlighting the strength of this method in ensuring the target population are contactable.

Another possible disadvantage of online surveys is that, due to their increased use, there is a risk of 'over-surveying' whereby people are asked to take part in so many surveys that they stop responding to any surveys. Manfreda et al. (2008) found that the response rate for online surveys was 11% lower than other methods of survey data collection. This is a key drawback of this method. In order to counteract this effect, it is important to make sure that the survey is pitched so that the respondents understand its value and the benefits of taking part. If this is not done correctly non-response could bias the results. Non-response bias, and the attempts made to counteract this will be discussed in Section 8.8.

Furthermore, respondent characteristics and circumstances could also bias the results. For example, the respondent could have a lack of motivation to answer fully, or they could be multi-tasking or distracted during completion of the online survey, also suggesting a lack of motivation. Other survey methods, such as face-to-face and telephone surveys, limit the respondents' ability to be distracted during survey completion. Therefore, attempts need to be made to ensure that respondents are actively involved in the survey during its completion. The current survey employed a number of methods to counteract this effect which will also be discussed when addressing survey design.

Therefore, whilst the ease of using online surveys is highly beneficial to researchers, it is also important to take into consideration drawbacks of the method which need to be considered both prior to and during data collection. This chapter will now discuss the decisions made in designing the survey, to account for any of the aforementioned problems with survey data.

8.2 Software

In order to conduct the online survey, the Qualtrics software was used. Qualtrics is an online research platform which allows online surveys to be developed and distributed. The survey can be developed and tested online before being made live and open to respondents. Respondents can access the survey using a link that Qualtrics provides. Cardiff University have a subscription to Qualtrics meaning that staff and students can access the tool online. As the software was accessed via the Cardiff University license, the design of the questionnaire was specified by the university and included the Cardiff University logo at the top of each page. Once the survey data was collected the raw data could then be downloaded onto the SPSS software for univariate and bivariate analysis. The Stata software was used for regression analysis.

8.3 Sampling methods

8.3.1 Target population

The goal when designing sampling methods is that the sample can be generalised to the target population. The first step in doing this is defining who the target population are. The target population for the current survey is *'classroom teachers in primary, secondary, further education (FE) and special schools, in England and Wales'*. This criterion contains three components:

1. **Classroom teachers**: Classroom teachers refers to those individuals who lead a class on a day-to-day basis and are responsible for the children in their class. They are paid professional teachers and have received a form of formal teacher training in order to carry out their role. This, therefore, excludes teaching assistants from the target population. However, a decision was made to include headteachers who, although they may not be formally teaching on a day-to-day basis, have received the necessary training, and tend to be involved in decision making about allocating resources to special educational needs (SEN) or additional learning needs (ALN) children.

2. **Primary, secondary, FE and special schools:** Dyslexia can be noticed and picked up at any age, however, it is very unusual to be recognised at pre-school age. Furthermore, in order to compliment the findings from the MCS, in which they start asking about dyslexia at age 7, no teachers or nursery workers from pre-primary school were recruited. A primary school is a school that children attend from age 4 or 5 to age 11. In primary school the students go through Key Stage 1 (in England) and Foundation Phase (in Wales) (ages 5 to 7), followed by Key Stage 2 (ages 7 to 11). Children attend secondary school from ages 11 to 16 which is currently subdivided into Key Stage 3 (ages 11 to 14) and Key Stage 4 (ages 14 to 16). Secondary schools often include sixth-from colleges which is at Key Stage 5 (ages 16-18). If students do not remain in their secondary school, they may go to a different FE setting for post-16 education. In Wales compulsory school age is ages 5 to 16. In England compulsory school age is ages 5 to 18. Teachers from 'special schools' were also recruited; these schools cater for specific educational needs.

3. **England and Wales:** Surveying teachers in England and Wales allowed analysis of the differences in understanding between teachers within the different education systems. The education system in Wales has had secondary powers devolved since 1999 and gained primary law making powers following the 2011 referendum. Therefore, recently the system has begun to significantly diverge from the English education system. However, approaches to ALN remained similar at the time of the data collection.

8.3.2 Sampling design

The second step in sampling was to locate a sampling frame. The sampling frame is a list of elements which enables eligible members of the population to be identified and contacted. This creates a list-based sample from which to survey. As the questionnaire was issued in the form of an online survey, email addresses were needed in order to send the link of the questionnaire to the potential respondents. As individual email addresses for teachers are not

publicly available, it was decided that the individual school headteachers would be contacted and asked to circulate the survey to their teaching staff. It would then be the responsibility of the headteacher to distribute the survey to the teachers in the school.

A list of English school email addresses was obtained via the Freedom of Information (FOI) service in England. The FOI Act 2000 provides public access to information held by public authorities. Therefore, the service was emailed (please see Appendix C for full communication with the FOI service). The reply states that while the headteachers' details were not held, an email address was available for all of the schools in the form of a CSV file. From examining the file, this was either an 'admin' email address, or the headteacher's email address. The same request was sent to the FOI service in Wales who stated that the contact details of each school could be found on their webpage. Therefore, using the suggested websites, a further CSV file was created with the school name and relevant email address for all schools in Wales. The mail-merge tool on Microsoft was then used to send an email, containing the link to the survey, to all of the primary, secondary and FE schools in England and Wales.

As it was then the responsibility of the receiver to distribute the survey to the relevant members of staff, it could not be ensured that everyone who answered the survey would meet the above target population criteria. Therefore, demographic questions were asked to assess the demographics of the respondents. Those that did not fall within the criteria were excluded from the analysis post data collection.

8.4 Survey type

As it was possible to contact all schools in England and Wales, the sampling took the form of an attempted census whereby all schools which had teachers in the target population were contacted. However, as mentioned in Section 8.3.2, it was not possible to directly contact all teachers, and therefore, the schools were relied upon to pass the survey onto their staff. This therefore, led to a type of opportunity sample in which those in the target population who received the email were sampled. This may have caused problems in how representative the sample was, as it could be

possible that those that received the email were unrepresentative of the target population. Therefore, further analysis was conducted in order to understand whether those that did not take part were missing at random, or whether there was any pattern to their non-response (Section 8.6).

8.5 Sample size

In order to be able to generalise to the target population, the size of the sample is important. Probability theory suggests that "in 95% of samples, the population percentage will be within ± two standard error units of the sample percentage" (DeVaus, 2002, p.232). The standard error is calculated by the following equation:

$$SE = \sqrt{PQ \div N}$$

SE= Standard error for the binomial distribution

P= % in the category of interest of the variable

Q= % in the remaining category(ies) of the variable

N= number of cases in the sample (adapted from, DeVaus, 2002, p.232)

Therefore, in order for a more accurate confidence interval a smaller standard error is needed. As the equation above demonstrates, a smaller standard error is achieved with a larger sample size.

To make the survey population an accurate reflection of the target population a small sample error is required. Sample error is "the extent, reflected by the standard error statistic, to which the sample differs for the population" (DeVaus, 2002, p. 364). Table 8.1 shows the suggested sample size for various sampling errors at a 95% confidence level, using a simple random sampling method, and assuming a 50% split on the variable of interest.

Table 8.1 Sample error for sample size

Sampling error %	Sample Size
1.0	10,000
1.5	4,500
2.0	2,500
2.5	1,600
3.0	1,100
3.5	816
4.0	625

(Table adapted from DeVaus, 2002, p.81)

The table shows that in order to halve the sample error, the sample size needs to be quadrupled, therefore, going beyond a certain sample may have insufficient payoff in terms of accuracy. Furthermore, the current survey is examining a finite population (the teaching population in England and Wales). Both governments provide these numbers, therefore, we know that there were 521,055 teachers on the pay roll in 2016. This can then be included in the calculation of appropriate sample size using the 'finite population correction' formula provided by Moser and Kalton (1971). Table 8.2 shows the necessary sample size for different sampling errors at the 95% confidence level, adjusted for the population size:

Table 8.2 Sample error for sample size adjusted for population size

Sampling error %	Sample Size
1.0	9,431
1.5	4,234
2.0	2,390
2.5	1,533
3.0	1,065
3.5	783
4.0	600

Using the sampling frame specified in Section 8.3.1, 4,134 teachers started the survey and 2,700 teachers responded to the whole survey. Using the same formula, this is a margin of error of 2% meaning that we know that there is a possible range of 2% above and below the response obtained from the sample. This should be considered when analysing the results in addition to the significance at the level of the question.

8.6 Representativeness of final sample

In order to determine whether the final sample was representative of the target population, it was necessary to compare the final dataset with the data provided by the English and Welsh governments on their 'school workforce'. From this it was possible to determine the number of teachers that fell within the target population. Both governments keep up-to-date statistics on their teaching staff and their demographics. This is published yearly on the respective government statistics webpages. Using this information, it was possible to compare the final survey sample with the statistics in order to see whether the survey sample was representative. From the information that the government provide it was possible to determine the teachers' school type (e.g. primary, secondary or special school) and their sex. However, other demographic information, which may be relevant, such as teacher category (e.g. senior teacher) and the number of years that the person has been teaching, was not provided by the governments. Therefore, while analysis of survey representativeness could be done on school type, sex and country, it could not be done on other variables, meaning that some caution needed to be taken when generalising the results. Table 8.3 lists the demographic data from the survey sample and compares it with the information on the teaching workforce. Z-scores were calculated in order to examine whether the demographics of the survey population were different to the government recorded demographics. Z-scores beyond the critical value (± 1.96) would suggest that there was a significant difference between the survey sample and the teaching work force.

Table 8.3 Comparison of survey and population demographics

		Survey Sample (%)	Teaching workforce (%)
Country	**England**	95.3	94.9
	Wales	5	5.1
Sex	**Male**	17.8	24.8
	Female	82.2	75.2
School type	**Primary**	47.6	49.1
	Secondary	43.3	46.4
	Special	**9.4**	**0.1**

Percentages in bold indicate z-scores beyond +1.96

Table 8.3 shows that the there was no significant difference between the survey sample and the teaching workforce, on the country that the teacher worked in, and their sex. There was also no significant difference between the datasets in whether the teacher was from a primary or a secondary school. However, significantly more teachers from special schools, than were in the population, responded to the survey. It could be hypothesised that this was because teachers in special schools had a more specialised knowledge of SEN and felt more able to respond to the survey. However, this meant that the survey sample was over representing teachers from special schools. In order to counteract for this, the data was weighted so that teachers from special schools carried less weight.

Overall, however, apart from the overrepresentation of teachers from special schools, there was no substantial difference in the demographics of the survey sample and the target population. This, therefore, suggests that although a census was not achieved, the sample broadly represented the target population.

8.7 Weighting

As previously mentioned, the data could be weighted to account for any difference between the population and the survey sample. Population figures were obtained from the Departments of Education in England and Wales. Table 8.4 shows the percentage of teachers in the categories of Teacher Setting, Country and Sex in the population. Table 8.5 shows the percentages in the survey data.

Table 8.4 Population demographics

		Male	Female	Total
England	Primary	33,300 (6.39%)	209,100 (40.13%)	242,400 (46.52%)
	Secondary	82,900 (15.91%)	145,700 (27.96%)	228,600 (43.87%)
	Special and PRU	6,300 (1.21%)	17,000 (3.26%)	23,300 (4.47%)
Wales	Primary	2,204 (0.42%)	11,468 (2.2%)	13,672 (2.62%)
	Secondary	4,299 (0.83%)	8,065 (1.55%)	12364 (2.38%)
	Special and PRU	193 (0.04%)	526 (0.1%)	719 (0.14%)
Total		**129,196 (24.8%)**	**391,859 (75.2%)**	**521,055 (100%)**

Table 8.5 Survey demographics

		Male	Female	Total
England	Primary	171 (4.48%)	1540 (40.37%)	1711 (45.17%)
	Secondary	389 (10.2%)	1174 (30.77%)	1563 (40.97%)
	Special and PRU	76 (1.99%)	274 (7.18%)	350 (9.17%)
Wales	Primary	11 (0.29%)	81 (2.12%)	92 (2.41%)
	Secondary	27 (0.71%)	62 (1.63%)	89 (2.34%)
	Special and PRU	5 (0.13%)	5 (0.13%)	10 (0.26%)
Total		**679 (17.8%)**	**3136 (82.2%)**	**3815 (100%)**

Population percentages were divided by the sample percentages in order to create the weights for each subgroup. These were then applied to the data in order to weight it. After weighting the data, the survey demographics reflected the demographics of the population.

As well as running the analysis on the weighted data, the analysis was also run on the unweighted data (Appendix D). Univariate analysis with the unweighted data showed no large discrepancies due to weighting. Furthermore, during bivariate analysis only three relationships changed significance due to weighting. All of which involved small changes due to differences in sex, country and additional training (related to setting). This

further suggests that the sample population was an accurate reflection of the target population.

8.8 Non-response

Using the above method of sampling meant that there were two possible opportunities for the target population to not respond. Firstly, the headteacher or admin staff members who received the email may not have circulated the link to their teaching staff, and secondly, if the link did get circulated, the teachers may have chosen not to respond. It is commonly known that teaching is a time-consuming role, and teachers are often pressed for time, therefore, it was important to ensure that the survey was produced in a way which would not be burdensome for the respondent.

Non-response can result in two issues. Firstly, it may result in a small sample size, increasing the sampling error. Secondly, it can cause 'non-response bias' whereby the type of people who complete the survey may be different to those who choose not to, therefore, biasing the results. A post-hoc approach to non-response bias is to weight the results so that they are representative of the target population. This approach was taken after data collection, before analysing the results (Section 8.7). However, decisions were also made when designing the survey that helped to keep non-response to a minimum.

Non-response can occur in three different ways, firstly, potential respondents can choose not to complete the survey at all. Secondly, participants can drop out during survey completion, and finally, respondents my not answer certain questions either purposely or by accident (item non-response).

8.8.1 Survey invitation

To address the first issue of non-response, the survey invitation was designed to increase the likelihood of survey take-up (see Appendix E for full survey invitation).

Personalisation of invitations has been shown to be a significant predictor of whether or not a potential respondent starts the survey (Heberlein & Baumgartner, 1978; Heerwegh 2005; Joinson, Woodley &

Reips, 2007; Yammarino, Skinner & Childers, 1991). Using the mail-merge tool, it was possible to send an individual email to each school. As it was not possible to know the headteacher's name, the email was addressed to each school. As well as personalising the addressee's name, the school name was also included within the body of the email to reinforce the personalised nature of the email. The respondent was also informed about the subject of the survey, and the benefits of their contribution to the research. For the schools in Wales, the invitation to the survey was also provided in Welsh.

Crawford, Couper and Lamias (2001) found that telling the respondents that the survey would have a short completion time had a lower non-response rate than a longer completion time. Therefore, the approximate completion time was included in the survey information. Appendix F details the text that was provided when the respondent clicked on the link to the survey. This reinforced the nature of the survey and the short length of time that it would take to complete.

8.8.2 Style elements

Addressing the style of the questionnaire aided both with respondents dropping out of the survey during completion, and item non-response. Vicente and Reis (2010) suggest that the issues with non-response can be split into two main areas; task elements, which are factors that influence the way that the respondent responds to the task of filling in the questionnaire, and, style elements, which are factors associated with the look and style of the questionnaire. Both task and style elements can have a significant effect on non-response rates. Style elements will now be discussed. Discussion of task elements will be discussed in relation to the design of the induvial questions in Section 8.9.

Firstly, it was possible to choose between scroll and screen designs (Vicente & Reis, 2010). A scroll design is where the questions are presented on a single web page and the respondent is required to scroll down the page in order to answer the questions. The screen design is where the questions appear on several pages, and the respondent is required to answer the questions on that page before submitting them and moving to the next page.

Manfreda, Batagelj, and Vehovar (2002) found that there was more item non-response on a scroll design survey than a screen design survey. However, other studies have found no significant difference between the two survey types (Peytchev, Couper, McCabe & Crawford, 2006; Tourangeua, Couper, Galesic & Givens, 2004). This survey provided a hybrid version of these types of survey whereby questions of a similar nature were provided on the same page, which the participant had to scroll through, before moving to the next page.

Research has also been conducted into whether a progress bar should be included on the survey to inform participants of their progress during the survey. A progress bar fills up as the respondent makes their way through the online survey, indicating how much of the survey is left. Whereas, in paper surveys the respondent is aware of how much of the survey is left, in online surveys the decision needs to be made as to whether or not the participant should be informed of their progress. Vicente and Reis (2010) summarise research on the area and suggest that "the respondents' perception of burden is more important than the burden itself" (p.262) Therefore, if the respondent does not see the progress moving significantly forward it can increase dropout rates. Consequently, they suggest that inclusion of a progress bar is more rewarding for the respondents in short questionnaires but may be de-motiving in longer questionnaires. As the current questionnaire was short a progress bar was included.

8.8.3 Measurement error

As well as bias in the data from non-response, there may also be bias from measurement error whereby the response given is not an accurate reflection of the 'true answer'. Error could either occur from the respondent due to a lack of motivation or understanding, or due to the survey instrument as a result of poor wording or design. In an interviewer-based survey, the interviewer can act as a mediator in order to address these issues, however, in online surveys the respondent has to rely on their own understanding to correctly interpret the question and produce an accurate response. Couper (2000), therefore, states that:

in order to minimize respondent error, the survey instrument must be easy to understand and to complete, must be designed to keep respondents motivated to provide optimal answers, and must serve to reassure respondents regarding their confidentiality (Couper, 2000, p.475)

Krosnick (2000) proposes the following steps to reduce measurement error:

1. *Maximise respondent motivation:* This can be done by stating the value of the research and keeping the questionnaire short.

The current survey states the importance of the survey in the invitation email, and thanks the participants for their support in order to increase their motivation. They are also told at the beginning that if they are interested in the results they will need to provide their email address at the end. This should motivate the teachers to complete the survey if they are interested in receiving the results.

2. *Minimise task difficulty:* This can be achieved by keeping the questions simple, asking about only one thing per question, and providing clear instructions throughout.

The current survey aimed to keep questions simple and provided information about how to respond to each question throughout.

3. *Minimise response effects:* In order to minimise response effects, questions need to be asked in a balanced way to avoid leading questions.

Krosnick (2000) suggests that questions with binary options (e.g. yes or no) should be avoided to reduce measurement error.

DeVaus (2002) also proposes three guiding principles when developing questions in order to minimise measurement error:

1. Exhaustiveness (or inclusiveness): Ensuring that there is sufficient range of responses so that all respondents feel as though they can answer. Consequently, it is suggested that for some questions it can be appropriate to use an open category where respondents can provide their answer should it not be included in the list.
2. Exclusiveness: This principle suggests that for each question the respondent should only provide one answer. Therefore, each

item should be thought of as a separate variable whereby the respondent 'is' or 'is not' in the category. Consequently, questions should be designed to address this principle.

3. Balancing categories: Unbalanced categories can produce bias. To ensure that categories are balanced, when categories can be ordered from low to high, there should be an equal number of categories either side of the 'neutral value'. (Adapted from DeVaus, 2005)

How the survey meets these criteria will be highlighted when discussing the design of questions (Section 8.9).

8.8.4 Open- or closed-ended questions

An open-ended question is a question in which the respondent can provide their own response. A closed-ended question is a question where there are a fixed number of responses which the respondent is required to choose between. Closed ended questions are easier to respond to, and therefore, reduce the time that it takes to complete the questionnaire (Vicente & Reis, 2010). In a meta-analysis of survey responses Manfreda and Vehova (2002) found that there tended to be a higher drop-out rate in surveys that included open answer questions or questions that were difficult to answer.

There are advantages and disadvantages to both types of question. A key problem with closed answered questions is that they can force the respondent to make "false opinions, either by giving an insufficient range of alternatives from which to choose or by prompting people with acceptable answers" (DeVaus, 2002, p.99). Therefore, it does not consider the subtlety of individual differences in people's opinions. On the other hand, open-ended questions allow the respondent to provide their own individual response to the question, allowing more subtlety and individuality in the response. However, there are also disadvantages to open-ended questions as they require the researcher to code and classify the responses into groups. Therefore, the researcher has to interpret the respondents' opinion adding potential researcher bias. Consequently, perhaps closed-ended questions are preferable for this reason, as the respondent can classify themselves rather than allowing the researcher to classify them, thus removing the bias from interpretation.

Another advantage of closed-ended questions is that they do not discriminate between respondents with different capacities and resources. Whereas, full completion of an open-ended question requires both the time to write a response, and the literacy skills to put opinions into words, closed-ended questions put this burden with the researcher who has to design a question with potential responses that will encompass all potential respondent opinions. Therefore, if closed-ended questions are used, care needs to be taken in designing the questions to encompass all possible responses.

The current questionnaire included mostly closed-ended questions, however, provided the 'other' or 'unsure' criteria to ensure that respondents who did not feel like they fitted within one of the options were able state an alternative. Two open-ended question were used in the questionnaire. The first was to find out what respondents believed dyslexia to be. Research has shown an advantage of using online surveys for text entry questions in order to produce richer responses compared with self-administered pen and paper questionnaires (Barrios, Villarroya, Borrego & Ollé, 2001; Kiernan, Kiernan, Oyler & Gilles, 2005). The research aimed to find out what teachers believed dyslexia to be, therefore, a detailed and rich response would reveal the intricacies of these beliefs. If this question had been done in a close-question format it would have had to give different definitions of dyslexia for the respondent to choose between. This would have forced the teachers to make a judgement, rather than providing their own understanding of dyslexia. For this reason, an open-ended question was used, and the responses were then coded.

The second open-ended question was used to find out what additional training the respondent had received around dyslexia. As different schools and organisations offer training in a variety of different ways, it would have been difficult to produce an all-inclusive list which encompassed all varieties of different training. Callegro, Manfreda and Vehova (2015) suggest that "whenever an exhaustive list of response options can be specified- and respondents know all of them- we recommend using a closed-ended format" (p.70). However, in this case, the list of interest cannot be specified, and a method used in one institution may not be

familiar to another. Therefore, this was an open-ended question which was coded after data collection.

8.8.5 Inclusion of the middle alternative

In questions where teachers had to rate their opinion on a scale, a decision had to be made as to whether or not to include a neutral response (e.g. neither agree or disagree). The advantages of doing this are that including the middle option avoids the creation of a directional opinion, which the respondent may not hold. However, not providing a middle option means that respondents cannot 'sit on the fence' and have to indicate their preference for a particular option. Furthermore, respondents may select the middle option as a form of 'laziness' as they do not want to commit to a particular question. An advantage of not including a middle option is that the dimensions can be recoded and reduced to binary options which may aid in analysis (e.g. agree vs. disagree) (Nadler, Weston & Voyles, 2015). This survey chose not to include a middle option for these reasons.

8.8.6 Coding

If the respondent selected 'other' for any question, their responses had to be coded into the appropriate category. Furthermore, the inclusion of the open-ended question about dyslexia and training type, also meant that responses had to be coded. As mentioned above, an issue with open-ended question is that the researcher is required to interpret and classify the participant into categories. This classification process can affect the way that data are analysed, therefore, it was important to make careful decisions when coding responses.

The respondents that answered 'other' in questions about their demographics, were recoded if they fitted within the target population characteristics. Those that did not fit within the required target population were coded as missing and removed from the study as their responses were not indicative of the target population. Coding methods for individual questions is discussed below (Section 8.9.1- 8.9.3).

8.9 Individual question design

This methods section will now discuss each question that was included in the survey, discussing how it was asked and its format within the questionnaire. The questionnaire was designed to be short for maximum response rate. There were three main sections to the questionnaire (see Appendix G for full survey).

8.9.1 Part 1: Respondent characteristics

The demographic questions were presented as closed ended questions. They could either be presented as radio buttons where all of the options are shown, and the respondent could click the answer that they best associated with, or drop-down boxes where a mouse click revealed the possible options. The current survey chose to present the respondent characteristics options using the radio buttons option as Couper, Tourangeau, Conrad & Singer (2006) found that this method showed a higher completion rate. Furthermore, Vincete and Reis (2010) summarise that "the radio button format instead of drop-down boxes […] seems to work in favour of lower item non-response" (p.263).

Setting type. Firstly, the participants were asked about the setting that they taught in. The following options were given to align with the specified target group:

- Primary School
- Secondary School
- Further education (Post 16)
- Special school
- Other

The 'other' category was included to meet the 'exhaustiveness' principle set out by De Vaus (2002). Those that responded 'other' were then coded into one of the above groups depending on their response. This was done in accordance with the corresponding age group that the schools fell under. Common responses were middle school (recoded as primary as the age group is 7 years to 11 years); preparatory school (recoded as primary as the age group is 8 years to 13 years); and infant schools (also recoded as

primary as the age group is 4 years to 7 years). Schools such as hospital schools, pupil referral units, prison schools and schools catering for a specific learning need were recoded as special schools. Rather than recoding these groups into groups of their own, teachers were coded into these categories as these were the categories that the English and Welsh governments provided in their databases about the teaching workforce. Therefore, the data could be weighted in accordance with these groups. Those that did not fit within the above categories were left as 'other' and were then marked as missing.

Teacher category*.* Teachers were then asked about the type of teacher they were. The following options given were:

- Headteacher
- Class teacher
- Teaching assistant
- Special Educational Needs Coordinator (SENCo)
- Other

As the current research specifically focuses on class teachers who have had the necessary training, those that responded, 'teaching assistant' were coded as missing for analysis. However, the option was given as the email may have been forwarded to the them by the receiver and providing this option made it easier to classify and exclude them from analysis. SENCos were identified specifically in order to see if there were any differences between those that had a specific role working with students with SEN. Once again, the 'other' category was included to meet the 'exhaustiveness' principle set out by DeVaus (2002). These were recoded to reflect the most appropriate category above. Most of the those who selected 'other' were either a member of senior leadership (such as a deputy head), or head of a particular department. As the current practice is that these teachers have completed teacher training, and work with students daily, they were recoded as class teachers.

Unfortunately, the government does not provide statistics about the number of each category of teacher that they have in their employment. Therefore, this could not be considered when weighting the data.

Sex. Participants were asked if they were male or female. While there is some controversy in only including the 'male' or 'female' options, in order to accurately weight the data in accordance with the government statistics, it was necessary to keep this binary option as the governments do not currently report any other sex categories.

Years teaching. In order to see if there were any differences in understanding due to the length of time that the teacher had been in the work force, they were asked to state how long they had been teaching using the options:

- Currently training
- Newly Qualified Teacher (NQT)- 5 years
- 5-10 years
- 10+ years

Country and Language. As the survey was sent to teachers in England and Wales, teachers were asked to select their place of work from:

- England
- Wales
- Other

Only nine respondents selected the 'other' option for this question, they were coded as missing as they did not meet the target population criteria. Those that selected 'Wales' were asked about the type of language establishment they taught in. They could choose from:

- Welsh-medium establishment
- English-medium establishment
- Bilingual establishment
- Other

No teachers selected other for this question.

Type of teacher training. Guided by the government advice on getting into teaching[1] a list of the different routes to teacher training was provided for

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[1] getintoteaching.education.gov.uk

the respondents to choose between. They were asked "What form of teacher training did you complete/ are you currently completing?" They could choose between the options:

- Postgraduate Certificate in Education (PGCE)
- Teach First/ Schools Direct
- School-centred initial teacher training (SCITT)
- Graduate teacher programme (GTP)
- Assessment based route to Qualified Teachers Status (QTS)
- University-led undergraduate training (3+ years)
- Other

Those that selected 'Other' were then recoded to the most similar group from the list above. Often those that responded other were teaching assistants who were coded as missing from further analysis.

For ease of analysis the above options could then be recoded into 'university-led training' and 'school-led training' by recoding as follows:

- **University-led training:** PGCE; University-led undergraduate training;
- **School-led training:** Teach First/ Schools Direct; SCITT; GTP; Assessment based route to QTS.

Self-report of dyslexia. Teachers were also asked if they had dyslexia themselves in order to see if this would affect their responses. They could select:

- Yes
- No
- Unsure

The unsure category was included to meet the 'exhaustiveness' principle set out by DeVaus (2002).

Confidence about dyslexia*.* Teachers were also asked about their confidence in working with dyslexic students. This was phrased as "How confident do you feel in helping a dyslexic student achieve success?" for which they could choose:

- Extremely confident
- Somewhat confident
- Somewhat unconfident
- Extremely unconfident

In order to meet the balancing categories principle, set out by DeVaus (2002), there were two 'confident' options and two 'unconfident' options.

This variable was also recoded into a binary format whereby those who answered, "extremely confident" or "somewhat confident" were recoded into "confident" and those who answered, "somewhat unconfident" or "extremely unconfident" were recoded as "unconfident".

Knowledge of dyslexia. Finally, the participants were asked about their knowledge of dyslexia: "How much would you say you know about dyslexia?" from which they could choose the following options:

- I know a lot about dyslexia;
- I know a bit about dyslexia;
- I don't know much about dyslexia;
- I know nothing about dyslexia.

This was also recoded into a binary format. Those who responded, "I know a lot about dyslexia" and "I know a bit about dyslexia" were coded as "knowledge of dyslexia". Those who responded, "I don't know much about dyslexia" and "I know nothing about dyslexia" were coded as "little knowledge of dyslexia".

8.9.2 Part 2: Understanding of dyslexia

Definition of dyslexia. As this was a short survey addressing what teachers understood about dyslexia, it was necessary to gain some depth of their knowledge about dyslexia, in the quickest possible way. Therefore, an open-ended question was chosen so that participants could give the description that they wanted, without being influenced to choose a particular answer. The teachers were asked to "provide a short description of what [they] think dyslexia is".

Research has shown that the size of the text entry field is important in ensuring that the respondents answer open-ended questions. As this was a key question in answering the research questions, it was important to get an optimum response rate. Whilst a large text entry field increases the length of the response (Smyth, Dillman, Christian & McBride, 2009), a large text feild can also increase the perceived burden on the respondent and therefore increases item non-response (Zuell, Menold & Körber, 2015). The Qualtrics software provides the options 'single-line', 'multi-line' and 'essay text box'. The multi-line option was chosen so that the participant would know to write more than just a few words but would not be deterred by the burden of filling in an 'essay text box'.

The descriptions were then coded using Frith's (1999) causal model in which she suggests that dyslexia can be described at three separate levels- biological, cognitive and behavioural. The same coding methods was employed by Bell, McPhillips and Doveston (2011) (discussed in Section 3.3.3). This suggests that it is an operational coding system when coding definitions of dyslexia.

Descriptions coded as biological gave descriptors about the brain, neurological differences or genetics being the cause of the dyslexic symptoms. Descriptions were coded as cognitive if they mentioned the cognitive processes associated with dyslexia, such as processing differences, issues decoding, and memory problems. Finally, descriptions that were coded as behavioural mentioned the outward symptoms of dyslexia, mainly issues with reading, writing and spelling. If the participants mentioned more than one of these factors in their description, they were coded as having a combination.

Furthermore, De Vaus (2002) suggests that when coding the researcher should firstly look for broad groupings and themes in the first 50 to 100 responses. From conducting this procedure, the responses showed a theme which did not fit within the framework set out by Frith (1999). This was that many teachers were mentioning the visual aspects associated with dyslexia. As this appeared to be a key theme, along with coding the definitions using Frith's model, responses were also highlighted if they discussed any visual aspects.

Performance in academic areas*.* As well as asking what the teachers believed dyslexia was, it was also necessary to explore how they believed it effected their students within academia. It was of interest to gain a numerical value for this in order to determine if there were any subtle but significant differences between different academic subjects. Therefore, 'slider' rating scales were used. Each academic area was presented on a horizontal sliding scale, on which the teacher was required to indicate with a number where they fell between the positions on the scale. They were asked:

> I would like to find out how you think dyslexia affects students in different academic areas. Therefore, please use the scales below to indicate how you believe a person with dyslexia will perform in each area, in comparison to their peers. Select the response that in your experience should be the correct answer.

The scales ranged from 0 (labelled as 'worse than peers') to 100 (labelled as 'better than peers'), the mid-point 50, was also labelled as 'comparable to peers'. Grid lines were provided at 10-unit intervals to help the participant place the slider. The academic areas that were asked about were: maths, reading, science, writing, spelling, art, English literature, history, geography, and, foreign languages. These subjects were presented in a random order to each respondent to avoid context effects. Context effects are when "one question affects the processing and answering of the other questions" (Callegro, Manfreda & Vehovar, 2015). This was a particular issue with these questions as respondents may compare how they answer about one academic area, with how they answer about another academic area.

8.9.3 Part 3: Training experiences

The final section the questionnaire explored the respondent's training experiences. Once again radio buttons, rather than drop-down menus, were used for the respondents to select their answer.

Quality of teacher training. In order to assess the respondents' opinions on the quality of the teacher training they had received they were asked "In

your opinion how well was dyslexia covered on your teacher training programme?" They could choose from the options:

- Extremely well
- Very well
- Slightly well
- Not well at all

Additional training. As it was expected that schools would provide continued professional development (CPD) around areas such as dyslexia, the teachers were asked "Have you received any formal training on dyslexia (on top of any initial teacher training)? If Yes, what training have you received". Respondents were given the options 'yes', 'no' and 'unsure'. If they selected 'yes' they were asked to enter the type of training that they received into a text entry box. This was then coded into five categories after data collection:

1. In-house training (e.g. CPD, school inset)
2. Out of house training (e.g. training from external bodies such as the British Dyslexia Association or Dyslexia Action)
3. Lower qualification (those who has received a qualification around the area of dyslexia such as a National Vocational Qualification (NVQ) or diploma)
4. Higher qualification (those who had a Master's qualification around the area of dyslexia or were a qualified SENCo)
5. Other

8.9.4 Survey completion

When the respondents got to the end of the survey they were thanked with the following message: *"Thank-you very much for taking part in this survey. The results that you have provided will contribute significantly to my research. If you would like to receive a summary of the results of this survey please provide your email address below."*

8.10 Ethics

The research follows ethical guidelines as set out by the Cardiff University; prior to carrying out the survey the study was approved by Cardiff University School of Social Sciences Research Ethics Committee. Appendix H shows the relevant guidelines to this research and how they have been addressed in the current survey.

8.11 Response rate

The number of responses recorded by the Qualtrics software was 4,134. However, this simply showed the number of people who clicked on the link meaning it recorded the same person clicking on the link more than once. Therefore, it was necessary to look at the response rate for each item. Table 8.6 shows the response rate for each question comparing those who did, and did not, fall within the target population.

Table 8.6 Response rate for individual questions

Question	Number of responses	Number of responses from target population	Margin of error (for target population)
Setting type	3,922	3,417	1.67%
Teacher category	3,911	3,417	1.67%
Sex	3,903	3,417	1.67%
Years teaching	3,863	3,411	1.67%
Country	3,920	3,417	1.67%
Dyslexia (teacher self-report)	3,842	3,380	1.68%
Type of teacher training	3,744	3,365	1.68%
Confidence about dyslexia	3,838	3,380	1.68%
Knowledge of dyslexia	3,842	3,380	1.68%
Definition of dyslexia (open ended)	2,790	2,487	1.96%
Academic areas			
Maths	2,043	1,788	2.31%
Reading	2,722	2,422	1.99%
Science	2,048	1,806	2.3%
Writing	2,700	2,406	1.99%
Spelling	2,751	2,448	1.98%
Art	1,999	1,739	2.35%
English Literature	2,454	2,169	2.1%
History	2,149	1,896	2.25%
Geography	1,921	1,693	2.38%
Foreign Languages	2,325	2,060	2.15%
Quality of teacher training	2,614	2,446	1.98%
Further training	2,771	2,475	1.97%
Knowledge of dyslexia	2,770	2,472	1.97%
Provided email	886	796	N/A
Average	**2,905**	**2,570**	**1.95%**

The number of responses fluctuates from the beginning of the survey to the end. The number of responses drops by 29.4% in the whole number of responses, and by 27.7% within the target population. More people outside of the target population dropped out of the survey. This may be due them

feeling unable to answer the questions as they were aimed and the target population.

Interestingly, although it was an open-ended question, the response rate for the descriptions of dyslexia was not much lower than the average response rate. The lowest responses are for the academic areas. Perhaps, as the task was different for this question the respondents did not understand the task and therefore did not complete it. As the number of responses are different for each academic area, it could also be hypothesized that teachers who did not teach in those areas did not feel able to respond to the question about them. Nevertheless, the response rates for these questions did not fall outside a 2.4% margin of error.

8.11.1 Margin of error

As previously mentioned, as we know the sample size, and the size of the whole population, it was possible to calculate the margin of error for each question. Table 8.6 shows the margin of error for each question when only the target population are included. On average the margin of error was 1.95% meaning that there was a possible range of 1.95% above and below the calculated value. This margin of error was fairly small but was still important to consider when analysing the results.

8.12 Analysis methods

This methods section will now briefly explore the potential issues when analysing survey data, before exploring the analysis methods that were used.

8.12.1 Issues with measurement and analysis

As the current data collection attempted a census, but took more the form of opportunity sampling, there is some debate about the most appropriate analysis and inference to apply. Berk and Freedman (2003) state that "well-known methods of statistical inference, with standard errors, t-tests, and p-values […] depend critically on certain rather restrictive assumptions, for instance, random sampling" (p.235). Random sampling is when sample units are drawn and each unit in the population has an equal chance of being selected. While random sampling can be seen as the 'gold-standard' of

sampling methods, in reality it is hard to achieve. Berk and Freedman (2003) suggest that if the random sampling technique is not employed, there is more likely to be similarity within the respondents and this may lead to smaller p-values than samples which obtained a random selection of the population. Therefore, results that appear as statistically significant could merely be the product of chance variation. As the current survey was reliant upon the schools to distribute the survey to their relevant teaching staff, the process of survey allocation was not random. Therefore, care needs to be taken when applying certain statistical methods. However, initial non-response showed that the sample was, on-the-whole, representative of the population with regards to country, sex and school type. Berk and Freedman (2003) suggest that one way to deal with a non-random sample is to treat the data "as if" (p.239) they are representative of the target population. However, according to Berk and Freedman (2003), if this is done the results of a convenience sample can be used only to forecast what would likely be found, should the sample have been a random probability sample.

Yet Seddon and Scheepers, (2012) state that "researchers might reasonably use 'inferential statistics' such as p-values, if they can show that their sample is representative of the population of interest" (p.10.) Therefore, as shown in Section 8.7, using the data provided by the English and Welsh governments, it was possible to weight the dataset to so that the proportion of respondents in the dataset mirrored the proportion of respondents in the target population. Consequently, this research treats the data 'as if' it was collected randomly and applies the relevant weights to ensure that it represents the population where possible. Where not possible, rather than making generalizations to the target population, the research stipulates that similar results would be found, should the data have been collected using a random probability sample.

8.13 Analysis stages

After recoding the necessary variables, basic univariate analysis was conducted on all questions. This allowed for basic familiarisation with the data, and to understand the number of respondents that fell within certain categories. Following the univariate analysis, bivariate analysis was then conducted on the survey data (see Section 5.2.1 for full description of bivariate analysis). In order to investigate which factors were significant predictors of the teachers' responses, binary logistic regression was then used (see Section 5.2.2 for full description of regression analysis) (see Knight (2018) for full details).

8.13.1 Collinearity and multicollinearity between variables.
As explained in Section 5.2.2 it was important to determine if there was any collinearity between the variables. In order to determine whether there were any strong associations between predictor variables correlation statistics were generated. Table 8.7 shows these correlation statistics.

Table 8.7 Collinearity between variables

	1	2	3	4	5	6	7	8
Sex (1)	1.00							
Years teaching (2)	0.02	1.00						
Country (3)	-0.02	0.07	1.00					
Dyslexic (4)	0.04	0.04	0.01	1.00				
School/ Uni ITE (5)	-0.09	-0.26	-0.06	-0.05	1.00			
Setting (6)	-0.18	-0.07	-0.04	0.02	0.11	1.00		
Extra Training Type (7)	0.15	0.12	0.03	-0.04	-0.04	-0.06	1.00	
Extra Training (8)	0.04	0.04	0.01	-0.00	-0.05	-0.07	-0.08	1.00
Teacher category (9)	0.1	0.24	0.00	0.00	-0.04	-0.19	0.41	0.03

Collinearity between two variables was considered to be a problem if the correlation value fell above 0.8 (Field, 2013). Table 8.7 suggests that there are no obvious causes for concern between any of the predictor variables. There was a weak positive correlation between training type and teacher

category; and, between years teaching and teacher category. While these were fairly weak it should be taken into account in due course when explaining collinearity in the model.

8.14 Summary of Chapter

In order to collect data on teachers' understandings of dyslexia an online survey was used. The survey was emailed to all schools in England and Wales and yielded a response of, on average, 2,570 teachers in the target population (classroom teachers in primary, secondary, FE and special schools, in England and Wales). On the whole, the respondents were found to be representative of the target population, however the data was weighted to account for differences in the number of teachers who responded from special schools. The survey was designed to minimise non-response. The data was analysed using univariate and bivariate analysis and logistic regression.

CHAPTER 9

Teacher Survey - Results

9 | Teacher Survey – Results

9.1 Univariate analysis

This results section will now present the weighted univariate analysis of the questions in the survey.

9.1.1 Respondent demographics

The first part of the survey asked face sheet information about the respondents. Table 9.1 shows the weighted demographic information for the eligible respondents (i.e. those within the target population).

Table 9.1 Weighted participant demographics

		N	%
Setting	Primary	1,869	49.1%
	Secondary and post-16	1,776	46.3%
	Special (including PRU)	175	4.6%
Teacher category	Class Teacher	2,679	78.4%
	Headteacher	303	8.9%
	Special Educational Needs Coordinator (SENCo)	435	12.7%
Sex	Male	893	26.1%
	Female	2,524	73.9%
Years Teaching	Currently Training	72	2.1%
	Newly Qualified Teacher (NQT)- 5 years	686	20.1%
	5 – 10 years	654	19.2%
	10+ Years	1,999	58.6%
Country	England	3,237	94.7%
	Wales	180	5.3%
Teacher Training	Postgraduate Certificate in Education (PGCE)	1,843	54.8%
	Teach First/ Schools Direct	73	2.2%
	SCITT (school-centred initial teacher training)	110	3.3%
	Graduate teacher Programme (GTP)	256	7.6%
	Assessment based route to qualified teacher status (QTS)	61	1.8%
	University led undergraduate training (3+ years)	956	28.4%
	Other	66	2%
Whether Dyslexic	Dyslexic	244	7.2%
	Not Dyslexic	2,999	88.7%
	Unsure	137	4.1%
	Extremely confident	521	15.1%
	Somewhat confident	2,068	61.2%

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		N	%
Confidence about dyslexia	Somewhat unconfident	745	22%
	Extremely unconfident	55	1.6%
Knowledge of dyslexia	I know a lot about dyslexia	511	20.7%
	I know a bit about dyslexia	1,631	66.0%
	I don't know much about dyslexia	327	13.2%
	I know nothing about dyslexia	2	0.1%

9.1.2 Understanding of dyslexia

Definition of dyslexia. Participants were asked to "provide a short description of what [they] think dyslexia is". Responses were coded using Frith's (1999) causal model in which she suggests that dyslexia can be described at three separate levels: biological, cognitive and behavioural. If the participants mentioned more than one of these factors in their description they were coded as having a combination (Table 9.2).

Table 9.2 Definitions of dyslexia

Description code	**N**	**%**
Biological	85	3.4%
Cognitive	337	13.6%
Behavioural	1,304	52.4%
Biological and cognitive	14	0.6%
Biological and behavioural	49	2.0%
Conative and behavioural	551	22.2%
Biological, cognitive and behavioural	74	3.0%
Does not exist	2	0.1%
Other	71	2.8%
Total	**2,487**	**100%**

The most mentioned descriptions were behavioural desperations, followed by participants mentioning a combination of both cognitive and behavioural descriptors. The responses were then recoded to determine the total number of participants who mentioned or did not mention each type of descriptor.

Table 9.3 Definitions of dyslexia recoded

	Descriptor Mentioned	
	N	**%**
Biological	223	9%
Cognitive	976	39.3%
Behavioural	1,976	79.5%

Table 9.3 shows that a large majority of the respondents (79.5%) mentioned behavioural descriptors, followed by cognitive descriptors (39.3%). Biological descriptions were the most uncommon (9%).

Furthermore, it was also noted if the participant mentioned the visual factors associated with dyslexia. 420 descriptions mentioned visual factors. This was 16.8% of the descriptions.

Academic Area Analysis. Teachers were asked:

> I would like to find out how you think dyslexia affects students in different academic areas. Therefore, please use the scales below to indicate how you believe a person with dyslexia will perform in each area, in comparison to their peers. Select the response that in your experience should be the correct

The participants were required to select the point on a scale ranging from 0 to 100, for each academic subject. Table 9.4 shows the mean score and standard deviation for each subject area.

Table 9.4 Teachers rating of dyslexic students' performance in comparison to their peers

Subject Area	Mean	Std. Deviation
Spelling	23.02	12.65
Reading	29.25	11.67
Writing	30	12.16
Foreign Languages	35.92	16.49
English Literature	37	14
History	44.06	14.35
Geography	48	15.01
Science	51.3	15.27
Maths	51.38	16.2
Art	65.9	15.13

Table 9.4 shows that teachers believed that dyslexic students would perform worse than their peers in all subjects questioned except art, science and maths. Of interested, expected spelling performance *(M= 23.08)* was significantly lower than reading *(M= 29.22), t(2621)=-28.03, p<0.001,* while expected reading performance *(M= 29.1)* was significantly lower than writing *(M= 30.1), t(2581)=-5.09, p<0001.*

9.1.3 Teacher training experiences

Quality of teacher training*.* Teachers were asked "In your opinion how well was dyslexia covered on your teacher training programme?" Table 9.5 shows that a large majority of respondents (71.8%) said that dyslexia was not covered well at all on their teacher training programme.

Table 9.5 In your opinion how well was dyslexia covered on your teacher training programme?

Response	N	%
Extremely well	21	0.8%
Very well	153	6.3%
Slightly well	517	21.1%
Not well at all	1,755	71.8%
Total	**2,446**	**100%**

Additional training*.* Respondents were also asked if they had received any additional training on top of their initial teacher training. Table 9.6 shows that the majority of teachers (50.4%) reported that they had no additional training on dyslexia.

Table 9.6 Have you received any additional training on top of your initial teacher training?

Response	N	%
Yes	1,102	44.5%
No	1,247	50.4%
Unsure	125	5.1%
Total	**2,475**	**100%**

Those that responded 'yes' were prompted to say what type of training they had received, Table 9.7 shows the number of responses for each coded category.

Table 9.7 Additional training type

Response	N	%
In-house training	530	52.8%
External body training	228	22.7%
Lower qualification	137	13.7%
Higher qualification	77	7.7%
Other	31	3.1%
Total	**1,004**	**100%**

The majority of teachers (52.8%) had received in-house training coded as any continued professional development (CPD) which was provided in the form of in-house training.

9.2 Bivariate analysis

This results section will now present the results from the weighted bivariate analysis of the variables in the survey.

9.2.1 Respondent demographics and dyslexic understanding

Initial bivariate analysis was conducted between the demographic characteristics of the respondents and whether biological, cognitive or behavioural descriptors were provided. Chi-squared analysis was used in order to determine whether there was any significant difference between the observed and expected value in each cell. Those who responded with 'unsure' or 'other' to any questions were coded as missing for the bivariate analysis. Table 9.8 shows the bivariate analysis results.

Setting. There was no significant difference between the teacher setting and whether they gave a biological descriptor when describing dyslexia: $X^2(2)= 2.76$, p=0.25. However, a significant effect of setting type was found on whether the respondents provided a cognitive response: $X^2(2)= 9.25$, p=0.01. Table 9.8 shows the number and percentage of teachers who mentioned cognitive factors. Post hoc analysis using adjusted standardised

residuals scores showed that there were **significantly more primary school teachers than expected** (z=3.0), **and significantly less secondary and post-16 school teachers** (z=2.9) **used cognitive descriptors**. There was no significant difference of setting type and whether behavioural descriptors were used: $X^2(2)= 5.464$, p=0.07 and whether a visual descriptor was used $X^2(2)= 0.122$, p=0.94.

Teacher category. There was no significant difference between the type of teacher that responded and whether they gave a biological descriptor when describing dyslexia: $X^2(2)= 0.01$, p=0.99. However, a significant effect of teacher category was found on whether the respondents provided a cognitive response: $X^2(2)= 33.94$, p<0.001. Table 9.8 shows the number and percentage of teachers who mentioned cognitive factors. Post hoc analysis using adjusted standardised residuals scores showed that **significantly less class teachers** (z=-5.7), **and significantly more headteachers** (z=2.3) **and SENCos** (z=5.0) **mentioned cognitive descriptors**. There was no significant difference of type of teacher and whether behavioural descriptors were used: $X^2(2)= 2.15$, p=0.34. However, there was a significant effect of teacher category and whether visual factors were mentioned: $X^2(2)= 27.7$, p<0.001. **Class teachers were significantly more likely to mention visual factors** (z=5.0), **whereas, SENCos were significantly less likely to mention visual factors** (z=-4.8).

Sex. There was no significant difference between male and female teachers and whether they gave a biological descriptor when describing dyslexia: $X^2(1)= 0.9$, p=0.34. However, a significant difference between males and females was found in whether a cognitive response was provided: $X^2(1)= 4.82$, p=0.03. **Significantly less male teachers than expected mentioned cognitive factors, compared to females**. In addition, a significant difference was found between male and female teachers in whether or not behavioural descriptors were used: $X^2(1)= 11.72$, p<0.001. **Males were significantly less likely to mention behavioural descriptors compared to females.** There was no significant difference between males and females in whether visual factors were mentioned: $X^2(1)= 1.65$, p=0.2.

Years teaching. There was no significant difference of the number of years the respondent had been teaching and whether they gave a biological descriptor when describing dyslexia: $X^2(3)= 0.246$, p=0.25. However, there was a significant effect of years teaching on whether a cognitive descriptor was provided: $X^2(3)= 16.45$, p<0.001. Post hoc analysis showed **that those that had been teaching from NQT to 5 years were significantly less likely to give cognitive descriptor of dyslexia** (z=-3.2), whilst **those that had been teaching for more than 10 years were more likely to provide a cognitive descriptor of dyslexia** (z=3.7). There was no significant difference of the number of years the respondent had been teaching and whether they gave a behavioural descriptor when describing dyslexia: $X^2(3)= 5.27$, p=0.15. However, there was a significant effect of years teaching on whether visual factors were mentioned: $X^2(3)= 21.38$, p<0.001. **Those who had been teaching from NQT to 5 years were more likely to mention visual factors** (z=3.7), **whereas those who had been teaching for more than 10 years were less likely to mention visual factors** (z=-4.3).

Country. There was no significant difference between whether the respondent taught in England or Wales on whether they provided a biological: $X^2(1)= 0.19$, p=0.87; cognitive: $X^2(1)= 1.06$, p=0.3; behavioural: $X^2(1)= 0.46$, p=0.5; or visual: $X^2(1)= 1.21$, p=0.27 description of dyslexia.

Whether dyslexic. There was a significant difference in teachers who reported to have dyslexia, compared to those who do not have dyslexia, on whether or not they provided a biological description of dyslexia: $X^2(1)= 8.27$, p=0.004. **Those that had dyslexia** (z=2.9) **were significantly more likely to use a biological descriptor than those that did not have dyslexia** (z=-2.9). There was also a significant effect of having dyslexia on whether or not teachers provided a cognitive description of dyslexia: $X^2(1)= 7.54$, p=0.006. **Those that had dyslexia** (z=2.7) **were significantly more likely to use a cognitive descriptor than those that did not have dyslexia** (z=-2.7). Furthermore, there was also a significant difference in teachers who reported to have dyslexia, compared to those who did not have dyslexia, on whether or not they provided a behavioural description of dyslexia: $X^2(1)= 10.76$, p=0.001. **Those that had dyslexia** (z=-3.3) **were significantly less**

likely to use a behavioural descriptor than those that did not have dyslexia (z=3.3). A further of effect of having dyslexia was found in that **those with dyslexia** (z=-3.9) **were significantly less likely to mention visual factors than those without dyslexia** (z=3.9): $X^2(2)= 15.53$, p<0.001.

Confidence about dyslexia. Respondents were asked "How confident do you feel in helping a dyslexic student to achieve success?" Responses were coded into the binary format 'confident' and 'unconfident'. There was a significant effect of feeling confident on whether the respondent used a biological descriptor: $X^2(1)= 8.77$, p=0.003. **Those who felt confident were significantly more likely to use a biological descriptor** (z=3.0) **than those who felt unconfident** (z=-3.0). There was also a significant effect of feeling confident on whether the respondent used a cognitive descriptor: $X^2(1)= 52.88$, p<0.001. **Those who felt confident were significantly more likely to use a cognitive descriptor** (z=7.3) than those who felt unconfident (z=-7.3). Furthermore, a significant effect of feeling confident was found on whether the respondent used a behavioural descriptor: $X^2(1)= 4.94$, p=0.026. **Those who felt confident were significantly less likely to use a behavioural descriptor** (z=-2.2) than those who felt unconfident (z=2.2). **Finally, those that were confident** (z=-5.5) **were significantly less likely to use a visual descriptor** compared to those who were confident (z=5.5): $X^2(1)= 30.66$, p<0.001.

Knowledge of dyslexia. Respondents were also asked "how much would you say that you know about dyslexia?" Responses were coded into a binary format "knowledge of dyslexia" and "little knowledge of dyslexia**.** There was a significant effect of having knowledge of dyslexia on whether the respondent used a biological descriptor: $X^2(1)= 22.2$, p<0.001. **Those who reported that they had knowledge of dyslexia were significantly more likely to use a biological descriptor** (z=4.7) than those who had little knowledge (z=-4.7). There was also a significant effect of having knowledge of dyslexia on whether the respondent used a cognitive descriptor: $X^2(1)= 48.28$, p<0.001. **Those who reported that they had knowledge of dyslexia were significantly more likely to use a cognitive descriptor** (z=6.9) than those who had little knowledge (z=-6.9).

Furthermore, there was a significant effect of having knowledge of dyslexia on whether the respondent used a behavioural descriptor: $X^2(1)= 5.36$, p=0.021. **Those who reported that they had knowledge of dyslexia were significantly less likely to use a behavioural descriptor** (z=-2.3) than those who had little knowledge (z=2.3). Finally, there was a significant effect of knowledge of dyslexia on whether visual factors were mentioned: $X^2(1)= 5.36$, p=0.021. **Those, that said that they had knowledge** (z=-2.8) **were significantly less likely to use a visual descriptor** than those who said that they had no knowledge (z=2.8)

Summary of respondent demographics by dyslexic understanding. Initial bivariate analysis showed that those that are more likely to mention the biological aspects associated with dyslexia were significantly more likely to be dyslexic themselves, more likely to feel confident about working with dyslexic students, were more likely to say that they had knowledge of dyslexia. Those that were significantly more likely to mention cognitive factors were primary school teachers, head-teachers or SENCos, females, those that had been teaching for more than 10 years, were dyslexic themselves and reported more confidence and knowledge on dyslexia. Those that mentioned the behavioural aspects associated with dyslexia were more likely to be male, not dyslexic themselves, and reported less confidence and knowledge about dyslexia. Finally, those that were more likely to mention visual aspects were class teachers, had been teaching 5 years or less, were not dyslexic and reported less confidence and knowledge about dyslexia.

Table 9.8 Teacher characteristics by descriptor given

Teacher characteristic	Whether mentioned (compared to not mentioned)							
	Biological		Cognitive		Behavioural		Visual	
	n	%	n	%	n	%	n	%
Primary	107	8.4	**537**	**42.3**	**1,032**	**81.2**	217	17
Secondary	101	9.2	*398*	*36.1*	858	77.9	182	16.5
Special	12	13.5	34	38.2	66	74.2	15	16.7
Class teacher	177	8.9	*721*	*36.5*	1,573	79.5	**372**	**18.7**
Headteacher	18	9	**94**	**47**	152	76.4	26	12.9
SENCo	27	8.8	**161**	**52.4**	251	81.8	*22*	*7.2*
Male	65	9.9	*235*	*35.7*	*492*	*74.9*	101	15.2
Female	158	8.6	**742**	**40.6**	**1,483**	**81.2**	319	17.4
Currently training	8	14.3	16	28.6	47	83.9	8	14.3
NQT-5 years	37	7.3	*168*	*33.1*	**421**	**82.9**	**114**	**22.3**
5 – 10 years	40	8.6	177	38.1	364	78.4	91	19.5
10+ years	137	9.4	**614**	**42.2**	1,142	78,4	*206*	*14.1*
England	212	9	932	39.5	1,872	79.4	403	17
Wales	10	7.9	44	34.9	104	81.9	17	13.3
Dyslexic	**28**	**14.8**	92	48.4	*134*	*70.5*	*13*	*6.8*
Not Dyslexic	*187*	*8.6*	837	38.3	**1,759**	**80.5**	391	17.8
Confident	**186**	**10**	809	43.5	*1,459*	*78.5*	272	*14.6*
Unconfident	*35*	*6*	*156*	*26.7*	**484**	**82.7**	144	24.4
Knowledge of dyslexia	**208**	**10.2**	856	42.1	*1,608*	*79.1*	328	*16.1*
Little knowledge of dyslexia	*6*	*1.9*	66	*21.4*	**261**	**84.7**	70	**22.4**

Those in **bold** had a z score of +1.96 meaning that this category was more likely to mention the descriptor, those in *italics* has a z score of -1.96 meaning that this category was less likely to mention the descriptor.

9.2.2 Training experience by demographics

Bivariate analysis was also conducted in order to investigate whether there was any effect of respondent characteristics on their experiences of training and whether they had received any additional training on dyslexia. Table 9.9 shows the results of this analysis.

Setting. There was a significant effect of teacher setting on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(2)= 38.16$, $p<0.001$. The responses to this question were coded into a binary format of "covered well" and "not covered well". Post-hoc analysis using adjusted standardised

residuals showed that **primary school teachers were significantly more likely to say it was not covered well** (z=5.9), whilst **secondary school teachers were significantly more likely to say that it was covered well** (z=6.2). There was also a significant effect of the type of setting that the respondent worked in, and whether they had received any additional training on dyslexia: $X^2(2)= 6.12$, p=0.047. **Those that worked in a primary school were more likely to have received additional training** (z=2.4) **than those who worked in secondary schools** (z=-2.4).

In addition, there was also a significant effect of the respondents setting and the type of extra training that they had received: $X^2(8)= 61.87$, p<0.001. **Respondents who worked in primary schools were significantly less likely to have received in-house training** (z=-6.4) **and were significantly more likely to have received external body training** (z=5.3) **or have a higher qualification** (z=2.7). **Respondents from secondary schools were significantly more likely to have received in-house training** (z=7.3) **and were significantly less likely to have received external body training** (z=-5.5) **or hold a higher qualification** (z=-2.5). Furthermore, **those who worked in a special school were significantly more likely to hold a lower qualification** (z=2.7).

Teacher category. There was a significant effect of teacher category on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(2)= 9.49$, p=0.009 . Post-hoc analysis showed that **class teachers were significantly more likely to say it was covered well** (z=3.1), whilst **SENCos were significantly less likely to say that it was covered well** (z=-2.5). There was also a significant effect of the type of teacher, and whether they had received any additional training on dyslexia: $X^2(2)= 124.82$, p<0.001. **Those that were class teachers were significantly less likely to have received additional training** (z=-10.9). **Headteachers** (z=4.3) **and SENCos** (z=9.8) **were significantly more likely to have received additional training.** In addition, there was a significant effect of teacher category and the type of extra training that they had received: $X^2(6)= 215.02$, p<0.001. Respondents who were **class teachers were significantly more likely to have received in-house training** (z=12.8) **and were**

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significantly less likely to have received external body training (z=-6.1), have a lower qualification (z=-5.9), **or a higher qualification** (z=-6.5). **Headteachers were significantly less likely to have received in-house training** (z=-2.8) **and were significantly more likely to have received external body training** (z=3.8). Furthermore, **SENCos were significantly less likely to have received in-house training** (z=-12.7) **but were significantly more likely to have received external body training** (z=4.1), **hold a lower qualification** (z=7), **or hold a higher qualification** (z=7.9).

Sex. There was no significant effect of sex on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(2)= 0.87$, p=0.38 . However, there was a significant difference between males and females, and whether they had received any additional training on dyslexia: $X^2(1)= 8.38$, p=0.004. **Males were significantly less likely to have received additional training** (z=-2.9) than females (z=2.9). In addition, there was also a significant difference between males and females and the type of extra training that they had received: $X^2(3)= 54.45$, p<0.001. **Males were significantly more likely to have received in-house training** (z=7.4) **and were significantly less likely to have received external body training** (z=-4.1) **or hold a lower qualification** (z=-3.6).

Years Teaching. There was a significant effect of years teaching on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(3)= 34.53$, p<0.001. Post-hoc analysis showed that **those who had been teaching from 1 to 5 years** (z=4.6), **and 5 to 10 years** (z=2.1) **were significantly more likely to say it was covered well,** whilst **those who had been teaching for more than ten years were significantly less likely to say that it was covered well** (z=-5.7). There was also a significant effect of years teaching, and whether the respondents had received any additional training on dyslexia: $X^2(3)= 152.88$, p<0.001. **Those that were currently training** (z=-3.0), **NQT to 5 years** (z=-10.0), **5-10 years** (z=-3.2) **were significantly less likely to have received additional training. Those that had been teaching for more that 10 years were significantly more likely to have**

received extra training ($z=11.6$). In addition, there was also a significant effect of years teaching on the type of extra training that they had received: $X^2(9)= 23.37$, p=0.005. **Respondents who had been teaching from NQT to 5 years were significantly less likely to hold a higher qualification** ($z=-2.8$). **Those that had been teaching for more than 10 years were significantly less likely to have received in-house training** ($z=-2.5$) **but were significantly more likely to hold a lower** ($z=2.2$) **and higher** ($z=2.9$) **qualification.**

Country. There was a significant effect of country on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 4.95$, p=0.026 . Post-hoc analysis showed that **those who were teaching in England were significantly more likely to say it was covered well** ($z=2.2$), **than those who were teaching in Wales** ($z=-2.2$). There was no significant effect of country on whether the respondents had received any additional training on dyslexia: $X^2(1)= 1.244$, p=0.28. There was also no significant effect of country on type of extra training that they had received: $X^2(3)= 3.69$, p=0.298.

Teacher Training. There was a significant effect of whether or not the respondent had school based or university based teaching training on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 7.89$, p=0.005. Post-hoc analysis showed that **those who had university led training were significantly less likely to say it was covered well** ($z=-2.8$), whilst **those who had undergone school based teacher training were significantly more likely to say that it was covered well** ($z=2.8$). There was also a significant effect of the type of teacher training that the respondent received, and whether the they had received any additional training on dyslexia: $X^2(1)= 10.84$, p=0.001. **Those had university-based training were significantly more likely to have received additional training** ($z=3.3$) than those that had received school based training ($z=-3.3$). However, there was no significant effect of training type and the type of extra training that they had received: $X^2(3)= 2.35$, p=0.503.

Whether Dyslexic. There was no significant effect of whether or not the respondent had dyslexia on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 2.21$, p=0.137. However there was a significant effect of dyslexia on whether the respondent had received any additional training on dyslexia: $X^2(1)= 5.87$, p=0.015. **Those had dyslexia were significantly less likely to have received additional training** (z=-2.4) than those did not have dyslexia (z=2.4). There was no significant effect of dyslexia and the type of extra training that teachers had received: $X^2(3)= 0.2$, p=0.978.

Confidence about dyslexia. There was a significant effect of how teachers answered the question "how confident do you feel in helping a dyslexic person achieve success" on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 26.67$, p<0.001 . Post-hoc analysis showed that **those who felt confident were significantly more likely to say it was covered well** (z=5.2) than those that felt unconfident (z=-5.2). There was also a significant effect of confidence, on whether the respondents had received any additional training on dyslexia: $X^2(1)= 176.7$, p<0.001. **Those that were confident were significantly more likely to have received additional training** (z=13.3) than those that were unconfident (z=-13.3). In addition, there was also a significant difference between those that were, and were not, confident and the type of extra training that they had received: $X^2(3)= 30.13$, p<0.001. **Respondents who were confident were significantly less likely to have had in-house training** (z=-5.3), **and significantly more likely to have had external body training** (z=2.2), **hold a lower qualification** (z=2.7) **and hold a higher qualification** (z=2.8) than those who reported to be unconfident.

Knowledge of dyslexia. There was a significant effect of how teachers answered the question "how much would you say that you know about dyslexia" on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 23.15$, p<0.001 . Post-hoc analysis showed **that those who reported having knowledge of dyslexia were significantly more likely to say it**

was covered well (z=4.8) than those who reported little knowledge (z=-4.8). There was also a significant effect of knowledge, and whether the respondents had received any additional training on dyslexia: $X^2(1)$= 147.75, p<0.001. **Those that had knowledge were significantly more likely to have received additional training** (z=12.2) than those that had little knowledge (z=-12.2). In addition, there was a significant difference between those that had knowledge and those that had little knowledge, and the type of extra training that they had received: $X^2(3)$= 21.17, p<0.001. **Respondents who reported knowledge of dyslexia were significantly less likely to have had in-house training** (z=-4.6), **and significantly more likely to have had external body training** (z=2.4) **and hold a lower qualification** (z=2.6) than those who reported little knowledge.

Summary of demographics by training experiences. Bivariate analysis has shown that those that were more likely to say that dyslexia was covered well on their initial teacher education (ITE) were working in a primary school, were class teachers, had been a teacher for less than 10 years, worked in England, and undertook school-based ITE. The respondents that were significantly more likely to have received extra training were primary school teachers, headteachers or SENCos, females, had been teaching for more than 10 years, and had undergone university-based ITE. Finally, those that were more likely to have received in-house training were secondary school teachers, class teachers and males. Those that were more likely to have received external body training were primary school teachers, headteachers, SENCos and females. Those that were more likely to have received a lower qualification around dyslexia were more likely to work in a special school, be a SENCo, be female, and had been teaching for more than ten years. Those that were significantly more likely to have a higher qualification were those that worked in a primary school, headteachers or SENCos and had been teaching for more than ten years.

A significant effect of training experiences was also found on how respondents reported their confidence working with people with dyslexia and their knowledge around dyslexia. Those that felt confident were more likely to say that dyslexia was covered well on their ITE, and were more likely to have received additional training on dyslexia. Furthermore, those

that were confident were less likely to have had in-house training, and more likely to have had external body training and hold a lower or higher qualification. Similar results were found in those that reported having knowledge of dyslexia. Those that said that they had knowledge of dyslexia were more likely to say that dyslexia was covered well on their ITE programme, they were also more likely to have received additional training. In addition, respondents who reported knowledge of dyslexia were less likely to have had in-house training and were more likely to have had external body training, and hold a lower qualification than those who reported little knowledge.

Table 9.9 Teacher characteristic by training experiences

Teacher characteristic	How well was dyslexia covered on ITE		Received additional training		Additional training type							
	Covered well*		Additional training*		In house training		External body training		Lower qualification		Higher qualification	
	n	%	n	%	n	%	n	%	n	%	n	%
Primary	*52*	*4.2*	**587**	**46.9**	*237*	*45.2*	**157**	**30**	78	14.9	**52**	**9.9**
Secondary	**117**	**10.8**	*464*	*41.9*	**274**	**68.5**	*58*	*14.5*	47	11.8	*21*	*5.3*
Special	5	5.7	40	44.4	15	39.5	10	26.3	**11**	**28.9**	2	5.3
Class teacher	*154*	*7.9*	769	39	**459**	**68.2**	*120*	*17.8*	66	9.8	28	4.2
Headteacher	9	4.5	**120**	**58.8**	*44*	*41.9*	**40**	**38.1**	14	13.3	7	6.7
SENCo	**11**	**3.7**	**213**	**70.8**	*27*	*13.9*	**67**	**34.5**	**58**	**29.9**	**42**	**22**
Male	53	7.9	268	39.8	**169**	**76.1**	*27*	*12.2*	*15*	*6.8*	11	1.1
Female	122	6.9	**834**	**46.3**	*361*	*48.1*	**201**	**26.8**	**122**	**16.3**	66	8.8
Currently training	5	11.1	*14*	*25*	8	57.1	2	14.3	4	28.6	0	0
NQT-5 years	**59**	**11.7**	*125*	*24.8*	64	61	31	29.5	9	8.6	*1*	*1*
5 – 10 years	**44**	**9.3**	*181*	*38*	97	61.4	36	22.8	15	9.5	10	6.3
10+ years	65	4.6	**781**	**54.3**	*361*	*52.1*	158	22.8	**108**	**15.6**	66	9.5
England	**171**	**7.4**	1,293	1,049	510	55.1	212	22.9	131	14.2	72	7.8
Wales	*3*	*2.3*	80	53	21	43.8	16	33.3	6	12.5	5	10.4
University ITE	*130*	*6.3*	**942**	**45.9**	447	53.8	200	24.1	115	13.8	69	8.3
School based ITE	**38**	**10.4**	*139*	*36.8*	74	60.2	25	20.3	17	13.8	7	5.7
Dyslexic	19	9.8	*72*	*36.5*	31	53.4	14	24.1	9	15.5	4	6.9
Not Dyslexic	150	7	**989**	**45.5**	474	54	207	23.6	124	14.1	72	8.2
Confident	**162**	**8.8**	**979**	**52.6**	*444*	*51.4*	**212**	**24.6**	**132**	**15.3**	**75**	**8.7**
Unconfident	*13*	*2.3*	*121*	*21*	**84**	**78.5**	*16*	*15*	6	*5.6*	*1*	*0.9*
Knowledge	**169**	**8**	**1,044**	**49.1**	*489*	*53.4*	**219**	**23.9**	**133**	**14.5**	75	8.2
Little knowledge	*2*	*0.6*	*43*	*13.2*	**36**	**90**	*3*	*7.5*	*0*	*0*	1	2.5

Those in bold had a z score of +1.96 meaning that this category was more likely to give this response, those in *italics* has a z score of -1.96 meaning that this category was less likely to give this response.* compared to not covered well/ no additional training.

9.2.3 Training by description codes

It was also interesting to investigate how training influenced whether or not a biological, cognitive, behavioural or visual description of dyslexia was given when the respondents were asked to provide a short description of dyslexia. Table 9.10 shows the results of this analysis.

Biological. There was a significant effect of whether biological descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 7.8$, p=0.005 . Post-hoc analysis showed that **those who used a biological descriptor were significantly more likely to say it was covered well** (z=2.8) than those who did not mention a biological descriptor (z=-2.8). However, there was no significant effect of receiving any additional training, and whether the respondents mentioned the biological aspects associated with dyslexia: $X^2(1)= 0.66$, p=0.66. Yet, there was a significant effect of the type of extra training received and whether a biological descriptor was used: $X^2(3)= 9.34$, p=0.025. **Respondents who used a biological descriptor were significantly less likely to have had in-house training** (z=-2.7), **and were significantly more likely to have had external body training** (z=2.7)

Cognitive. There was no significant effect of whether cognitive descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 0.192$, p=0.66 . However, there was a significant effect of receiving additional training, and whether the respondents mentioned the cognitive aspects associated with dyslexia: $X^2(1)= 48$, p<0.001. **Those that had received extra training were significantly more likely to use a cognitive descriptor** (z=6.9) than those that had not (z=-6.9). Furthermore, there was also a significant effect of the type of extra training received and whether a cognitive descriptor was used: $X^2(3)= 20.18$, p<0.001. **Respondents who used a cognitive descriptor were significantly less likely to have had in-house training** (z=-3.7), **and were significantly more likely to have a lower qualification** (z=3.7)

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Behavioural. There was no significant effect of whether behavioural descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 0.012$, p=0.91. There was also no significant effect of receiving any additional training, and whether the respondents mentioned the behavioural aspects associated with dyslexia: $X^2(1)= 3.78$, p=0.052. Furthermore, there was no significant effect of the type of extra training received and whether a behavioural descriptor was used: $X^2(3)= 0.6$, p=0.896.

Visual. There was a significant effect of whether visual descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 4.37$, p=0.037. **Those that mentioned visual descriptors** (z=2.1) **were more likely to say that it was covered well** than those who did not mention visual descriptors (z=-2.1). There was also a significant effect of receiving additional training, and whether the respondents mentioned the visual aspects associated with dyslexia: $X^2(1)= 13.63$, p<0.001. **Those that had received extra training were significantly less likely to use a visual descriptor** (z=-3.7) than those that did not (z=3.7). Finally, there was also a significant effect of the type of extra training received and whether a visual descriptor was used: $X^2(3)= 12.07$, p=0.007. **Respondents who used a visual descriptor were significantly more likely to have had in-house training** (z=2.3), **and were significantly less likely to have a lower qualification** (z=-2.8)

Summary of training by descriptor codes. Bivariate analysis showed mixed effects of training experiences on whether biological, cognitive, behavioural and visual descriptors were used. Those that were more likely to use biological and visual descriptors were more likely to say that dyslexia was covered well on their ITE programme. Those that mentioned cognitive factors were significantly more likely to have had additional training, whilst those that mentioned visual factors were significantly less likely to have received additional training. Those that had received in-house training were less likely to mention the biological and cognitive aspects associated with

dyslexia but were more likely to mention visual factors. Finally, those that mentioned the cognitive factors associated with dyslexia were more likely to hold a lower qualification, while those that mentioned visual factors were less likely to hold a lower qualification.

Table 9.10 Descriptor used by training experiences

Teacher characteristic	How well was dyslexia covered on ITE		Received additional training		Additional training type							
	Covered well (compared to not covered well)		Additional training (compared to no additional training		In house training		External body training		Lower qualification		Higher qualification	
	n	%	n	%	n	%	n	%	n	%	n	%
Biological not mentioned	*141*	*6.7*	955	44.8	**480**	**56.1**	*192*	*22.4*	116	13.6	68	7.9
Biological mentioned	**25**	**11.9**	93	43.3	*34*	*40.5*	**30**	**35.7**	13	15.5	7	8.3
Cognitive not mentioned	98	7	*552*	*38.9*	**294**	**60.5**	112	23	*47*	*9.7*	33	6.8
Cognitive mentioned	68	7.5	**495**	**53.5**	*220*	*48.5*	110	24.2	**82**	**18.1**	42	9.3
Behavioural not mentioned	34	7.3	231	48.6	116	56	46	22.2	30	14.5	15	7.2
Behavioural mentioned	132	7.1	817	43.7	398	54.3	176	24	99	13.5	60	8.2
Visual not mentioned	*128*	*6.6*	**906**	**46.3**	*435*	*53.2*	190	23.2	**122**	**14.9**	70	8.6
Visual mentioned	**38**	**9.6**	*145*	*36.3*	**79**	**64.2**	32	26	*7*	*5.7*	5	4.1

* Those in **bold** had a z score of +1.96 meaning that this category was more likely to mention the descriptor, those in *italics* has a z score of -1.96 meaning that this category was less likely to mention the descriptor.

9.3 Multivariate analysis

Whilst binary analysis could show that there was a relationship between two variables, it could not show what the most important predictors were or what was causing the relationship. For example, it was found that a headteacher was more likely to provide a cognitive descriptor of dyslexia, however what remains unclear is, whether this was because they were a headteacher, because they had more years teaching, or because they had a higher level of training. Regression analysis allows us to untangle these relationships to find out the most important predictors of what type of descriptor the teacher gave. The following predictor variables were investigated: Setting; teacher category; sex; years teaching; country; school or university-based ITE; additional training; and, whether the teacher was dyslexic. As regression analysis looks for predictors of the dependent variable (in this case predictors of using a particular descriptor), it did not make sense to include variables that could be predicted by the dependent variable. Therefore, confidence, knowledge and whether dyslexia was covered well on ITE were not included in the regression. This was done because it could be hypothesised that having a certain knowledge of dyslexia may predict how the respondent answered these questions.

As having extra training, and the type of extra training were highly correlated (all those that had received no extra training had no extra training type), it was not possible to include both variables in the model. Therefore, the type of extra training was removed. This was removed as it is initially more useful to know the benefits of the extra training; the previous bivariate analysis is able to tell us the differences between the types of training without including it in the regression model.

9.3.1 Biological

The demographic variables were entered into the logistic regression model in order to determine the significant predictors of giving a biological descriptor of dyslexia. Insignificant variables were then removed one by one, with the most insignificant variable being removed first. The insignificant variables were removed in the following order:

1. Teacher category
2. Country
3. Sex
4. Extra training
5. Sex
6. Years teaching
7. School or university based initial teacher training
8. Setting

This meant that the only remaining significant predictor of giving a biological descriptor of dyslexia was the teacher being dyslexic themselves. Table 9.11 shows this model.

Table 9.11 Logistic regression biological descriptor

	Odds Ratio	Std. Err.	z	p	95% Conf. Interval	
Dyslexic (ref)						
Not Dyslexic	0.54	0.12	-2.68	0.01	0.34	0.85
Constant	0.18	0.04	-7.95	0.00	0.11	0.27

F=7.18, p=0.007, Mean VIF= 1.00

As this was a categorical variable the odds ratios could be converted into marginal effects which tell us the predicted probability of mentioning biological descriptors for those with and without dyslexia.

Table 9.12 Predicted probabilities biological descriptor

	Margin	Std. Err.	z	p	95% Conf. Interval	
Dyslexic	**0.149**	0.03	5.36	0.00	0.1	0.20
Not Dyslexic	**0.086**	0.01	13.83	0.00	0.07	0.1
Population average	**0.090**					

Table 9.12 shows that those with dyslexia are 6.3% more likely to mention the biological aspects of dyslexia compared to non-dyslexics. Dyslexics are also 6% more likely than the sample population average to use biological

descriptors. The findings from this regression analysis mirror the findings from the bivariate analysis that the only significant demographic predictor of giving a biological descriptor was the respondent having dyslexia.

9.3.2 Cognitive

The same process was repeated to look at predictors of whether the teacher provided a cognitive descriptor of dyslexia. The insignificant predictors were removed in the following order:

1. School or university based initial teacher education (ITE)
2. Sex
3. Years teaching
4. Country
5. Setting

This meant that the remaining significant predictors of giving a cognitive descriptor of dyslexia were:

- Whether the respondent had dyslexia
- Receiving additional training
- Teacher category

Table 9.13 shows this model.

Table 9.13 Logistic regression cognitive descriptor

Variable	Categories	Odds Ratio	Std. Err.	z	p	95% Conf. Interval	
Dyslexic	Dyslexic (ref)						
	Not Dyslexic	0.57	0.09	-3.37	0.00	0.42	0.79
Additional training	No Extra training (ref)						
	Extra training	1.66	0.16	5.45	0.00	1.39	2.00
Teacher category	Class teacher						
	Headteacher	1.47	0.24	2.34	0.02	1.06	2.03
	SENCo	1.71	0.23	3.95	0.00	1.31	2.22
Constant		0.76	0.12	-1.67	0.10	0.56	1.05

F=67.9, p<0.001, Mean VIF= 1.51

As the predictor variables were categorical variables the odds ratios could be converted into marginal effects which provide the predicted probability of mentioning cognitive descriptors.

Table 9.14 Predicted probabilities cognitive descriptor

Variable	Categories	Margin	Std. Err.	z	p	95% Conf. Interval	
Dyslexic	Dyslexic	**0.514**	0.04	13.52	0.00	0.44	0.59
	Not Dyslexic	**0.382**	0.01	34.92	0.00	0.36	0.40
Additional training	No extra training	**0.339**	0.01	23.86	0.00	0.31	0.37
	Extra training	**0.458**	0.02	28.06	0.00	0.43	0.49
Teacher category	Class Teacher	**0.369**	0.01	31.00	0.00	0.35	0.39
	Headteacher	**0.460**	0.04	12.13	0.00	0.39	0.53
	SENCo	**0.496**	0.03	16.33	0.00	0.44	0.56
Population average		**0.393**					

Table 9.14 shows that those with dyslexia are 12.1% more likely to use a cognitive descriptor of dyslexia than the sample population average. Those who had not received extra training were 11.9% less likely to provide a cognitive descriptor of dyslexia than those that had received training. Furthermore, class teachers were less likely than the sample population average to mention cognitive factors whilst headteachers and SENCos were more likely to mention cognitive descriptors.

Bivariate analysis also showed that teacher setting, sex and years teaching had a significant effect on whether the teachers gave a cognitive description of dyslexia. However, these variables were found to be insignificant when holding the other variables in the model constant. In the bivariate analysis, primary school teachers were more likely to mention cognitive descriptors, however, they were also more likely to have received extra training. This regression analysis suggests that mentioning cognitive factors does not appear to be related to setting, but rather, once additional training has been considered, this is the more important predictor. Furthermore, females were initially found to be more likely to use cognitive descriptors than males. Yet, like primary school teachers, females were

more likely to have had additional training, suggesting that this may have been driving the initial relationship, rather than the respondents' sex. Finally, years teaching also showed a significant relationship with mentioning cognitive factors. However, those that had additional training were more likely to have been teaching for longer, furthermore, headteachers and SENCos are likely to have been teaching for longer. The results from this regression analysis suggest that it is not the years teaching that is important, but the type of teacher and whether the respondent had any additional training, which explained this initially significant relationship.

9.3.3 Behavioural

The same procedure was also applied to those that mentioned the behavioural aspects associated with dyslexia. The insignificant predictors were removed in the following order:

1. Country
2. Teacher category
3. School or university based ITE
4. Years teaching
5. Setting

Therefore, the significant predictors of giving a behavioural descriptor were:

- Sex
- Having dyslexia
- Additional training

Table 9.15 shows the final model.

Table 9.15 Logistic regression behavioural descriptor

Variable	Categories	Odds Ratio	Std. Err.	z	p	95% Conf. Interval	
Sex	Male (ref)						
	Female	1.47	0.19	2.96	0.00	1.14	1.90
Dyslexic	Dyslexic (ref)						
	Not Dyslexic	1.68	0.31	2.81	0.01	1.17	2.42
Additional training	No Extra training (ref)						
	Extra training	0.79	0.09	-2.11	0.04	0.64	0.98
Constant		2.12	0.43	3.69	0.00	1.42	3.15

F=21.1, p<0.001, Mean VIF= 2.94

Once again, the odds ratios can be converted into marginal effects.

Table 9.16 Predicted probabilities behavioural descriptor

Variable	Categories	Margin	Std. Err.	z	p	95% Conf. Interval	
Sex	Male	**0.753**	0.02	35.6	0.00	0.71	0.79
	Female	**0.817**	0.01	88.8	0.00	0.8	0.84
Dyslexic	Dyslexic	**0.715**	0.04	20.3	0.00	0.65	0.78
	Not Dyslexic	**0.808**	0.01	89.0	0.00	0.79	0.83
Additional Training	No extra training	**0.817**	0.01	71.5	0.00	0.8	0.84
	Extra training	**0.779**	0.01	57.1	0.00	0.75	0.81
Population average		**0.795**					

Table 9.16 shows that males were 6% less likely than females to use a behavioural descriptor of dyslexia. In contrast with the biological and cognitive descriptors of dyslexia, those with dyslexia were 9% less likely to mention behavioural descriptors than those without dyslexia. Finally, those who had extra training around dyslexia were 4% less likely to mention the behavioural aspects compared to those who had not had training.

The results from this regression analysis mirror what was found as the significant predictors of giving a behavioural descriptor during bivariate analysis.

9.3.4 Visual

The same process was also applied to investigate the predictors of the respondent mention visual aspects in their description of dyslexia. The insignificant variables were removed in the following order.

1. Setting
2. School or university based initial teacher training
3. Country
4. Sex
5. Years teaching

Therefore, the following variables remained significant predictors of mentioning a visual aspect associated with dyslexia.

- Having dyslexia
- Received extra training
- Teacher category.

Table 9.17 shows the final model.

Table 9.17 Logistic regression visual descriptor

Variable	Category	Odds Ratio	Std. Err.	z	p	95% Conf. Interval	
Dyslexic	Dyslexic (ref)						
	Not Dyslexic	3.22	0.94	3.99	0.00	1.81	5.71
Additional training	No additional training (ref)						
	Extra training	0.72	0.09	-2.64	0.01	0.56	0.92
Teacher category	Class teacher (ref)						
	Headteacher	0.68	0.16	-1.65	0.10	0.43	1.07
	SENCo	0.35	0.09	-4.22	0.00	0.22	0.57
Constant		0.09	0.03	-8.50	0.00	0.05	0.16

F=45.88, p<0.001, Mean VIF= 1.51

Odds ratios could be converted into marginal effects for a clearer understanding of the differences between the groups.

Table 9.18 Predicted probabilities visual descriptor

Variable	Categories	Margin	Std. Err.	z	p	95% Conf. Interval	
Dyslexic	Dyslexic	**0.065**	0.02	3.76	0.00	0.03	0.1
	Not Dyslexic	**0.181**	0.01	20.73	0.00	0.16	0.2
Additional training	No extra training	**0.190**	0.01	16.69	0.00	0.17	0.21
	Extra training	**0.145**	0.01	12.13	0.00	0.12	0.17
Teacher category	Class Teacher	**0.188**	0.01	19.58	0.00	0.17	0.21
	Headteacher	**0.136**	0.03	5.20	0.00	0.09	0.19
	SENCo	**0.076**	0.02	4.56	0.00	0.04	0.11
Population average		**0.168**					

Table 9.18 shows that those without dyslexia (18.1%), those who had not had extra training (19%) and those who were class teachers (18.8%) were more likely than the population average (16.8%) to mention visual factors.

As with the cognitive descriptors, there were factors that were significant in bivariate analysis, which were insignificant in the regression analysis. Namely, years teaching was a significant predictor of giving a visual descriptor. However, years teaching is also associated with teacher category and whether the teacher had received any additional training on dyslexia. The results from the regression suggest that these factors were more important than years teaching in whether a visual descriptor was mentioned.

9.3.5 Summary of multivariate analysis

When holding other factors constant, whether the individual had dyslexia was consistently a significant predictor of the descriptors given. Those with dyslexia were more likely to mention the biological and cognitive aspects of dyslexia and were less likely to mention the behavioural and visual aspects. Furthermore, whether or not the respondent had received additional training also had an impact on the responses given, when holding the other variables in the model constant. Those who had extra training were more likely to use cognitive descriptors, and less likely to mention behavioural and visual factors. Headteachers and SENCos were also more likely to mention the

cognitive aspects associated with dyslexia, even when taking into account training experiences and years teaching. Furthermore, headteachers and SENCos were less likely to mention the visual aspects associated with dyslexia, whereas class teachers were more likely. Finally, females were more likely than males to mention the behavioural aspects associated with dyslexia, when taking into account the other variables in the model.

CHAPTER 10

Teacher Survey - Discussion

10 | Teacher Survey – Discussion

This chapter will discuss the results that arose from the teacher survey analysis. I will firstly discuss the findings in accordance with the predetermined research questions, before discussing the limitations of this research. A more general discussion chapter will follow this chapter; this will combine the key discussion from both the teacher survey and the Millennium Cohort Study analysis in order to draw conclusions about the dyslexia system as a whole.

10.1 Findings relating to research questions

10.1.1 What do teachers understand about dyslexia? (RQ6)

Firstly, Frith (1999) suggested that for a good understanding of dyslexia it is necessary to understand dyslexia at the biological, cognitive, and behavioural levels. However, only 3% of respondents described all three levels in their description of dyslexia, with 27.8% giving two or more descriptors. This meant that the majority of teachers (69.4%) described dyslexia using a single level. This was most commonly the behavioural level with 52.4% giving a behavioural description alone. Therefore, it appears that most teachers understand dyslexia in terms of how it affects pupils at the behavioural level. This supports findings from other research that has also shown teachers use behavioural descriptors when thinking about dyslexia (Bell et al., 2011; Mortimore, 2013; Washburn et al., 2014). It could be hypothesised that this is because teachers are more likely to witness the behavioural 'symptoms' associated with dyslexia in the classroom. However, as Frith (1995) suggests, it is important to understand all three levels of dyslexia. If teachers simply think of dyslexia as something that affects 'reading, writing and spelling' they may make assumptions about the pupil's expected performance in these areas. This concurs with a 'stereotypical' view of dyslexia. It would be more useful to think of dyslexia using all three levels of Frith's (1995) model. In particular it is useful for teachers to understand dyslexia at the cognitive level as the 'weaker' cognitive functions can be developed through effective teaching practice.

It was also noted that 16.8% of teachers mentioned visual factors. Therefore, nearly twice as many teachers mentioned visual factors than biological factors. This also supports findings from previous research that suggests teachers hold the understandings that dyslexia is a visual issue (Wadlington & Wadlington, 2005; Washburn, Joshi, & Binks-Cantrell, 2013). The current survey demonstrates that teachers mention visual issues, even when not prompted to consider them, despite research being inconclusive about this relationship.

As discussed in section 3.3.2, Babad (2009) theorised that teachers' expectations are often based upon commonly held stereotypes. It appears that the stereotypical view of dyslexia held by the teachers surveyed is that it is a primarily behavioural condition. Specifically, the surface traits of difficulties with reading, writing and spelling were commonly mentioned. This is supported by the fact that when asked how dyslexic students would perform in comparison to their peers, teachers gave the lowest scores for spelling, reading and writing. As teacher expectations may be based on these ideas, then it could be hypothesised that teachers may not expect their students with dyslexia to perform as well in these areas, potentially contributing to a self-fulling effect. However, evidence shows that with the right intervention dyslexic pupils can improve and achieve in these areas. As previously mentioned, the most effective interventions focus on improving cognitive processing (Rose, 2009; Snowling & Hulme, 2011). Consequently, it is vital that teachers are aware of this so that they can help their students most effectively, and so as not to lead to stereotypes which results in lowering the teacher's expectancy of their pupils.

The fact that teachers discussed the behavioural level aspects of dyslexia so frequently, also gives us information about the social representations that teachers hold about dyslexia. Geijer (2003) found that teachers spoke mostly about the surface level, behavioural aspects of dyslexia. In forming their social representations, teachers may base their knowledge of dyslexia on what is seen in the classroom. They may notice dyslexic students struggling with behavioural aspects such as reading, writing and spelling, and base their representation of dyslexia around this. A finding relating to this is that teachers stated that spelling skills would be worse than reading skills. This was an interesting result, as, as discussed in

Section 2.3, a large majority of work on dyslexia frames it through the lens of a problem with reading. It could be hypothesised that teachers are more likely to see examples of poor spelling in a pupil's work, than poor reading (which can be harder to notice, particularly in secondary school when reading skills are no longer part of the curriculum). This may explain why teachers rated spelling as being worse than reading, and supports the idea that teachers base their understanding of dyslexia on what they see in the classroom.

However, those that had been teaching for up to five years were significantly more likely to use behavioural descriptors than those who had been teaching for longer. This suggests that the experience of working with pupils in the classroom is not the only basis of teachers' understandings of dyslexia, or those working as a teacher for longer would be more likely to describe the behavioural aspects of dyslexia. Therefore, it is also necessary to question what other aspects may be shaping teachers' understandings, other than experiences in the classroom.

10.1.2 What other factors impact a teacher's understanding of dyslexia? (RQ7)

Whilst, overall, teachers were most likely to mention the behavioural factors associated with dyslexia, and were less likely to describe the biological and cognitive factors, differing circumstantial factors had a significant effect on how teachers described dyslexia. Regression analysis allowed predictors of a descriptor to be entered into a model, in order to untangle the relationship between variables.

Whether the teacher had dyslexia. A consistent factor that influenced the teacher's description was whether the teacher was dyslexic. Teachers who were dyslexic themselves were significantly more likely to use biological and cognitive descriptors and were significantly less likely to use behavioural and visual descriptors. It could be argued that those who had dyslexia themselves may be more aware of the underlying neurological and cognitive functioning aspects of dyslexia. Presumably, having undergone cognitive tests during their own dyslexia assessment, they will be more

aware of these aspects of dyslexia. Furthermore, it could be argued that a teacher with dyslexia would be less likely to simply think of themselves as struggling with reading writing and spelling, and may seek a deeper understanding of dyslexia in order to explain their symptoms. Having more knowledge of the biological and cognitive aspects associated with dyslexia, may have a positive impact on the students whose teachers have dyslexia. Furthermore, teachers with dyslexia may have higher expectancy for their own dyslexic students, as it can be assumed that they were able to achieve academically in order to become a teacher. Future research should look into the interaction between dyslexic teachers with their students in order to determine how the teacher's dyslexia may impact their expectancies.

Additional training. Whether or not the teacher had received additional training was also a significant predictor of the descriptors that they used. When entered into the regression models, receiving additional training was a significant predictor of providing a cognitive descriptor, whilst those who had received additional training were significantly less likely to provide a behavioural or visual description of dyslexia. This implies that they are less likely to hold a more stereotypical understanding of dyslexia and are also less likely to mention the inconclusive relationship between dyslexia and visual functioning. Furthermore, the results show that extra training increased teachers' confidence in helping students with dyslexia along with their self-reported knowledge of dyslexia. This suggests that extra training may have a significant positive effect on teachers' work with dyslexic pupils. However, the type of additional training was also important. Bivariate analysis showed that while additional training on the whole was important, those who had only received in-service training were less likely to use biological and cognitive descriptors and were more likely to use visual descriptors. Furthermore, those with in-house training were less likely to say that they had knowledge of dyslexia, and that they would be confident in helping a dyslexic student achieve success. Therefore, while on the whole extra training was important, it is also key to state that this must be good-quality training. Further research should look at what it is taught in in-house training which differs from other training types in order to

determine how continued professional development (CPD) could be improved.

Teacher category. The other significant predictor of descriptor given was whether the teacher was a class-teacher, a headteacher or a Special Educational Needs Coordinator (SENCo). Compared to headteachers and SENCos, class teachers were significantly less likely to provide a cognitive descriptor of dyslexia, and were more likely to give a visual descriptor. This could be expected as headteachers and SENCos may have been teaching for longer, and therefore would have received more extra training. However, this relationship was significant even once years teaching and extra training was controlled for. Therefore, it is interesting to question the differences between teacher categories and how this may influence their understanding. As headteachers and SENCos have less day-to-day interaction with students, this could explain why they may be more able to distinguish dyslexia from the individual and understand it as a cognitive processing issue. Whereas, class-teachers who have more contact with their dyslexic students may find it more difficult to make this distinction.

It is also interesting to question why class teachers were more likely to mention the visual aspects associated with dyslexia. One of the suggested methods to support students with visual stress is to print work on coloured paper or to provide coloured overlays so that there is not a stark contrast when reading black text on a white background (Wilkins, 2003). One potential reason why class teachers may be more likely to refer to visual processing is that this could be seen as a 'quick fix' for students in their class who are dyslexic. Providing work on coloured paper could be seen as a simple way to help the dyslexic student and the teacher may feel like they have helped to solve the issue. Therefore, they may be more inclined to think of dyslexia as a visual issue as this is easier to solve than a more complex cognitive processing issue which has no clear solution. Further research should explore these relationships between teacher category and understanding in more depth.

Sex. The final significant predictor of responses given was that female teachers were found to be more likely to give a behavioural response. It is

difficult to comprehend why this relationship is significant. Further research should be conducted in an attempt to understand why this may be the case.

Overall, there are many factors that influence a teacher's understanding of dyslexia. This contributes to the argument that dyslexia is a complex system, and there are many aspects, beyond the individual, that may influence their experiences with dyslexia.

10.2 Limitations

As participation in the survey was voluntary, teachers who responded could be deemed as more engaged with the subject of dyslexia than others. Consequently, this could cause potential bias in the sample. However, a large breadth of teachers with differing knowledge and experience were surveyed, therefore, the sample does not appear to be biased to a particular type of teacher. Furthermore, by weighting the data, the teacher population demographics of sex, school type and country were accounted for in the sample. Whilst theoretically teachers' views and inclinations cannot be weighted, this ensures that the sample mirrors the population, at least in demographic factors.

Another limitation of the current study is that it does not acknowledge the methods that teachers use when working with students with dyslexia. Therefore, while we can assume that poor knowledge leads to poor practice, this cannot be discerned from this study. Nevertheless, it is significant that the teachers surveyed lacked the knowledge of the cognitive aspects of dyslexia which have been shown to be important in effective interventions for those with dyslexic symptoms. Future research should investigate how a teacher's knowledge of dyslexia influences their practice. If it is found that poor knowledge of dyslexia leads to poor practice, this strengthens the argument for more thorough coverage of dyslexia during ITE and CPD.

CHAPTER 11

Concluding Discussion

11 | Concluding Discussion

The following chapter will now bring together the two separate studies in order to look at the dyslexia system as a whole. Implications for the dyslexia debate will be discussed, along with potential implications for policy and practice. Finally, strengths and limitations of this thesis as a whole will be deliberated, and directions for future research will be discussed.

11.1 The dyslexia system

As explored in Section 3.2, Bronfenbrenner's (1979) ecological systems model suggests that for a full understanding of a child's development it is important to look not only at the child themselves, but also the numerous factors in the child's environment that may impact their development. In addition, applying the understanding of complexity theory to look at this system, allows us to explore how there may be non-linear changes within this system which may lead to 'tipping points' or key changes for the individual. This thesis has applied these theories to look at the 'dyslexia system'.

Results from research using the Millennium Cohort Study (MCS) has shown that many factors other than biological aspects predict whether or not a child is labelled as dyslexic at different ages. This suggests that dyslexia is not an 'indifferent kind' that occurs with or without its classification (Hacking, 1999), rather results from the MCS provide evidence that that there is a larger system involved in dyslexia labelling that goes further than simply looking at the individual alone. This suggests therefore, that it is not a case of 'dyslexia' simply existing. Rather, what exists is a complex dyslexic system which forms what we understand about dyslexia. This provides justification for looking at dyslexia as a system, rather than focussing specifically on the biological, cognitive and/or behavioural aspects of dyslexia in the child.

Additionally, potential methodological issues, such as that teachers and parents were not in agreement over their child's dyslexia, and that those labelled in one sweep were not necessarily labelled in future sweeps, adds weight to the idea that dyslexia is a complex, multifaceted system.

Furthermore, the MCS research found that those with dyslexia experience lower academic self-concept, and lower academic aspirations in comparison to their matched peers. These lower aspirations were also found in the parents and teachers of the dyslexic individual. Therefore, although there may be no one thing that we can call dyslexia, the classification of dyslexia can have real consequences for those classified.

Given the importance of the 'dyslexia system' in labelling, it is also important to consider how this system may impact the individual's outlook. As Bronfenbrenner suggests that proximal processes with actors in the individual's micro-system will have the most significant impact on the child's development it was of interest to explore teachers' understandings of dyslexia. Findings from the teacher survey showed that teachers held a 'stereotypical' idea of what dyslexia is, relating it mainly to behavioural aspects, in particular 'difficulty with reading, writing and spelling'. This supports previous studies that have found similar understandings amongst teachers (Bell et al., 2011; Furnham, 2013; Mortimore, 2013; Washburn et al., 2014). The current research extends on these findings by showing that teachers' understandings of dyslexia, and attitudes towards working with those with dyslexia, also appeared to be impacted by whether they had received any additional training on dyslexia, whether they were dyslexic themselves and the type of teacher they were. This also indicates a complex system where many aspects may influence the child. In looking at this 'dyslexia system' it could be plausible to suggest that both teacher education, and teachers understanding could negatively impact a child's academic outlook. Particularly when considering psychological theories which emphasise the effect of teacher expectations on children and the possible self-fulfilling impact this could have on the child. Of course, taking the ideas of complexity theory into account, the system is too complex to simply say that teachers' understandings could directly impact the child's outlook. However, it seems important to note this finding, and consider how there may be many interactions between teacher education, teacher knowledge and child outlook. This may lead to a better understanding of where to implement change in the system with hope of improving the experiences for dyslexic individuals. Thus, understanding dyslexia as a

system is an important way forward in addressing the concerns raised from this research.

11.2 The dyslexia debate

Looking at the system in this way raises practical questions about the way that the current dyslexia system is working. It also provides another angle in investigating 'the dyslexia debate'. As discussed in section 1.2.2, the dyslexia debate (Elliot & Grigorenko, 2014) uses evidence from research into dyslexia to conclude that there is a lack of agreement on the definition of dyslexia, and thus, there are unclear distinctions between dyslexics and poor readers. However, within these arguments, little attention is given to the social consequences for the dyslexic individual, nor the factors outside cognition and biology that may also be involved in dyslexia. Results from this thesis contribute to the argument that the dyslexia label is unfit for use. The findings in support of this are threefold. Firstly, findings from the MCS show that the dyslexia label is not evenly distributed across the population. Those with greater economic and cultural capital are more likely to be labelled with dyslexia than those without. As the label can result in additional support and extra time, it could be argued that these resources are not being fairly allocated to those who need them the most. Secondly, in comparison to matched peers, the dyslexia label appears to be impacting the academic self-concept of those who hold it. This shows a negative impact of the label itself. Finally, the label evokes a stereotypical understanding of dyslexia in teachers, particularly those with less training. Therefore, teachers' expectations of dyslexic students appear to be impacted by the label itself.

These three key findings point towards failure in the current system, and therefore add weight to the conclusion of the dyslexia debate. Clearly, changes to the system are needed. I suggest three possible options for change. Firstly, that individuals continue to be diagnosed with dyslexia but that interventions are put in place to ensure that teachers' understanding is increased; that the uneven distribution of the label is considered in the diagnosis process; and, that recourses are allocated to those who need them. The second option is to retire the label of dyslexia, but to continue

diagnosing without using this label. Thirdly, a more radical option would be to not diagnose and to ensure that the education system functions in a way in which the symptoms associated with dyslexia are no longer seen as inhibiters to success. These three options will now be discussed in more detail.

11.3 Implications for policy and practice

It is clear from the findings presented in this thesis, that changes are needed within the current dyslexia system. Therefore, I propose the following three logical options for change.

11.3.1 Option 1: Keep the dyslexia label but change elements within the system

The first of the three options suggested is that while the label dyslexia remains, changes are put in place to improve the way the current system is functioning. Firstly, considerations of the predictors of dyslexia outside of cognitive test scores need to be taken into account. As suggested by Zoega, Valdimarsdóttir and Hernández-Díaz (2012) the effect of age in the year should be considered in diagnosis so that the possibility that the child is simply younger in the year is factored into the labelling process. This should also be applied to other aspects such as whether the child has an older sibling and sex, to ensure fair allocation of additional resources.

Furthermore, there needs to be changes in the system with regards to the accessibility of dyslexia to those from lower socioeconomic classes. There needs to be systems in place to firstly inform those from these milieus about the potential advantages of having a dyslexia label (for example extra time, access to specialist IT), and secondly to make resources more easily available for diagnosis. However, given that further findings showed a negative impact of diagnosis on academic self-concept, it could be argued that giving more people access to the label may not be advantageous to the individual.

A second option could be that diagnosis is not available privately and is funded by the state. This would result in the label being more fairly distributed. However, as dyslexia charities and interest groups are often

funded by private assessors, it is unlikely that they would push for this change. This presents challenges for this method of change. Furthermore, the current political environment is one of austerity with cuts being made across education and public services. Therefore, state-funded diagnosis is unlikely in the current political climate.

Alongside changes in the route to diagnosis, there also needs to be dramatic changes in teachers' understanding of dyslexia. While England's National Teaching Standards state that teachers must be able to engage with students with all needs (Department for Education, 2011), a large majority of teachers claimed that dyslexia was 'not covered well at all' on their initial teacher education (ITE) programme, suggesting they are ill-equipped to meet this requirement when entering the workforce. Therefore, an initial recommendation is for compulsory teaching of dyslexia on ITE courses in England and in Wales. This training should be evidence based, using up-to-date academic knowledge, which covers the biological, cognitive and behavioural aspects of dyslexia. Of particular importance is to provide knowledge of the cognitive aspects of dyslexia, such as phonological processing, which is known to inform the most effective interventions.

Secondly, as suggested by the Carter (2015) and Tabberer (2013) reviews on teacher training, continued professional development (CPD) is needed in order to increase the knowledge of teachers currently in the workforce (Department for Education and Skills, 2013; Department for Education, 2015). This training should be provided at regular intervals during a teacher's career to ensure that they are aware of the most up-to-date information and research on dyslexia. Therefore, a further direction for change is to implement evidence-based teacher education on the area of dyslexia. It is vital that teachers do not continue to think of dyslexia as a 'problem with reading writing and spelling' and begin to understand the more complex cognitive profile that will aid them when delivering intervention. This change needs be brought about both during ITE and CPD. However, as discussed when looking at the social representation of dyslexia, changes around discourse and representation do not happen overnight. Significant amounts of commitment and resources will need to be put in to slowly change the discourse around dyslexia amongst teachers so that it is not viewed in this stereotypical way. A strong argument could be put

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forward that the resources and time that would be needed to change this understanding is not conducive with the need for rapid change that the results from this thesis suggest is needed. This leads to my following suggestion for change which is to retire the label.

11.3.2 Option 2- Retire the dyslexia label but still assess

The second option is to stop diagnosing people with dyslexia. Here I am not arguing for no diagnosis, as diagnosis leads to unlocking support and extra resources for individuals who may need it. Rather, I propose that rather than diagnosing with dyslexia, that the individual is given a more specific diagnosis that relates directly to the areas in which the assessment shows need developing. Therefore, rather than saying that a person is dyslexic, they could be told that they show below average phonological processing, or working memory, for example. This would firstly, be more informative for the teacher as they could find out what can be done to improve the aspect (or aspects) that are flagged up. Furthermore, while these assessments could be used to justify extra support and resources directed at a student, it would not come with the negative aspects of the dyslexia label, whereby people associate it with lower literacy performance. While this option would aim to resolve issues around teacher understanding and the negative impact of the label on academic self-concept, it would not resolve the issue that assessment and subsequent diagnosis are not being fairly allocated. Therefore, this change would need to come alongside the change suggested above to make diagnosis publicly available and not available privately.

11.3.3 Option 3- Retire the dyslexia label and change the way the education system functions

My final suggestion is for key changes within the way that the current education system functions, which would mean that those showing dyslexic symptoms, would no longer be at any disadvantage. Tomlinson (2012) states that

> Inclusion should be based on a broad conception of social justice in education, moving from the endless categorisation and re-categorisation of young people judged to be failures in the system to

universal learning that accommodates the diversity of all students (p. 275).

While the potential for change is large, here I propose a few key changes which could be beneficial.

View dyslexia as a neurodiversity. As discussed in Section 2.3.1 there is momentum within other special educational need (SEN) categories to view those effected as neurodiverse. This suggests that any differences are a result of natural human variation, rather than any deficit or disorder. Therefore, rather than looking for weaknesses and difficulties in individuals, we embrace their differences. If the education system was to shift to this perspective, those who may be showing dyslexic-like difficulties may be able to embrace these differences and not view themselves as less capable.

Teach all children in a 'dyslexia friendly' way. A further change is that teachers adapt the established, successful dyslexia intervention programmes and incorporate them into their everyday teaching. For example, it is well-known that dyslexic individuals benefit from a multi-sensory learning approach, therefore, if the education system used these approaches in everyday teaching, then this may prevent the symptoms associated with dyslexia from developing. For example, Joshi, Dahlgren and Boulware-Gooden (2002) show that lessons combining auditory, visual and kinaesthetic learning instructions were significant in improving all children's phonological and decoding skills in comparison to those who received the standard reading programme. Furthermore, not only did those in the treatment group show gains in reading, they also showed improvements in reading comprehension and spelling. This therefore, suggests benefits of teaching in this way, beyond just benefiting those with dyslexic symptoms. Should teachers be taught to deliver all lessons using multi-sensory methods, then issues that dyslexics experience in mainstream teaching could be significantly reduced.

Additionally, while dyslexia has been linked with visual processing, it has been found that many children suffer from visual stress (i.e. difficulty reading black on white) regardless of whether they also show dyslexic

symptoms (Handler & Fierson, 2011). Therefore, another logical change could be to print all education resources, and examination papers on coloured paper. Again, this could benefit many children, not just those with dyslexia.

If all schools adapted their teaching and practices in a way that is 'dyslexia friendly' it could be argued that many children, not only those who may have dyslexia, will benefit.

Remove the hierarchy of subject areas. There is currently a hierarchy within the education system whereby literacy- and numeracy-based subjects are often viewed as more important than other subjects. Furthermore, within the current political climate budget cuts and subsequent loss of specialist teachers has led to a decline in provision in the arts and dramas in education (The Guardian, 14/03/2018). This call for change in what is viewed as important educationally, has been raised in previous academic research. Sternberg and Lubart (1995) argue that in the current education system creativity is often suppressed in favour of skills that are seen as more academic in nature. Furthermore, Rose (1985) discusses how writing ability is judged by the amount of errors the writer makes, rather than on the content and creativity of the writing. Yet, despite strong, evidence-based arguments being made in the past, the system remains in favour of those who show 'academic' skills as opposed to creativity. This, therefore, indicates that the current hierarchies are becoming more entrenched. This will impact more on state-funded schools who are competing for funding, staff, and against each other in league tables. Should emphasis be more evenly distributed among the subjects, then those with dyslexia symptoms may not suffer from lower academic self-concept, or lower aspirations, because they find these subjects more difficult. Rather, they could feel as though they are valued within the education system due to other areas of strength.

Change the examination system. In the education systems studied, academic achievement is mostly demonstrated through successful examinations. However, it can easily be argued that this method of assessment can disadvantage many people. If assessment was not based on

the ability to learn, memorise and recite knowledge in a written form this would enable those who show dyslexic symptoms, to present their knowledge in forms that are most suited to them.

A key potential change for the examination system could be to remove the time limit on examinations. Currently examinations are not only a test of what a student knows but how quickly they can write about it. It could be argued that a key reason that those from the highest social class seek a diagnosis for their child is because of the benefits of extra time in examinations. Therefore, if time limits were removed, there would be no need for this inequality to emerge. While, practically, research would need to be done on the best way for this to work, removing time limits would remove the need to be able to write at speed and would mean that those who lack this skill are not at a disadvantage.

These are just as few ideas for change in the education system. With changes like this in place, some of the issues raised within this thesis may be negated.

11.4 Strengths and limitations

11.4.1 Strengths

Firstly, this research has explored dyslexia as a system and in-turn how the system may influence the actors within it. Therefore, the thesis looks at the bigger picture of dyslexia in comparison to the majority of research in the field that looks at dyslexia at the individual level. As a consequence, the thesis has been able to illustrate the complexity within the dyslexia system with regards to both the diagnosis and the impact of the label. Looking at the system in this way has produced some valuable results and highlighted key areas for change. Thus, demonstrating the advantages of looking at a learning difficulty in this way.

Furthermore, the research methods and datasets used have allowed the complex relationships between different variables to be untangled and the patterns better understood. The use of a large-scale dataset enabled exploration of dyslexia at a macro-level, whilst the use of the teacher survey allowed closer exploration of how the teacher may impact this system. A

combination of the two datasets has provided an opportunity for the benefits of the MCS, with its large cohort and varied data, to be paired with a more specific survey focusing particularly on the area of dyslexia. The two datasets together have contributed to a better understanding of the dyslexia system.

The results have provided a novel contribution to the field using a new approach. While there have been calls for a change in the system due to a lack of clarity about how to define dyslexia, this thesis extends the debate by also highlighting the issues with the current system in previously unexplored areas; namely issues about who gets a diagnosis of dyslexia, how the diagnosis impacts the individual, and what teachers understand about dyslexia. Therefore, this thesis has taken a new approach to an existing debate and has provided rationale for change from another perspective.

11.4.2 Limitations

Section 7.2 and 10.2 have discussed the limitations of each dataset individually. I will now briefly discuss the limitations of the thesis as a whole. Firstly, a strength of this thesis could also be seen as its weakness. By acknowledging that the system is complex, I also recognise that it is not possible to fully understand how it functions. Therefore, while I have been able to use the data to look for patterns there may also be many other actors involved that may impact these relationships. While the datasets contain a large amount of relevant information, many relevant actors may remain unmeasured and thus, untested. Furthermore, while it was possible to see these patterns in the data, it was not possible to say why they were happing. For example, having an older sibling was a significant predictor of having a label of dyslexia, yet the reasons for why this is the case are far from clear. Therefore, while I can speculate about the possible reasons, further exploration is needed in order to fully understand these results.

Furthermore, both datasets look at teachers. However, as it is not the same sample of teachers in both datasets, we cannot assume that the teachers in the MCS survey hold the same understanding of dyslexia as the teachers in the primary survey data. Although data from primary survey was

weighted so it was representative of the teaching population, data from the MCS was weighted for the cohort member rather than the teacher. Therefore, we cannot assume that the teachers in the MCS were representative of the teaching population. Thus, while it would be a worthwhile conclusion to say that teachers hold lower aspirations for dyslexic students (finding from MCS) because they think of dyslexia as a behavioural issue centred around problems with literacy (finding from teacher survey), it is not possible to make the leap from one finding to another. However, due to the large numbers in both surveys, we can infer that there may be a relationship between these two findings, and that this points to a potentially fruitful area for further investigation in the future.

Finally, both studies employed the use of survey data. While this has allowed the research questions to be answered effectively, this method has not allowed any great depth of understanding of children's and teachers' perspectives and practices. Other qualitative research methods such as interviews and observations would have allowed these perspectives to be further understood. Therefore, in the following section, I discuss how these current findings should be expanded on with differing research methods.

11.5 Directions for future research

Further research in this area should aim to not only look at why the current mechanisms are in place, but also to begin to work towards making positive changes to the system.

Firstly, the current research needs to be followed up with in-depth research. While the current research found patterns in the dyslexic system, it offered no conclusions as to why these patterns exist. To further understand these patterns, qualitative methods need to be paired with further research in the area in order to delve deeper into the conclusions drawn from this research.

Additionally, the MCS research that is presented within this thesis should be repeated when each sweep of data is released. This will allow an understanding of whether there is an impact of development on the phenomena examined. For example, while the current research has shown that dyslexia has a negative impact on aspirations for going to university, it

will be interesting to examine whether these aspirations are fulfilled in the future. Furthermore, it can be expected that more cohort members will be labelled with dyslexia in future sweeps. This will allow a larger number of dyslexic children to be paired with the National Pupil Database (NPD). This will allow examination of how the dyslexia label has an impact on academic outcomes. As it has been found that there is a negative impact of dyslexia on academic self-concept, it is of interest to explore whether this negative effect also translates to academic performance. While Parsons and Platt (2017) found that those with a SEN made less progress than similarly abled peers, despite the SEN being identified and support in place, they were unable to distinguish between different categories of SEN. Therefore, they state that distinguishing between those with different needs is a "fruitful area for future research" (Parsons & Platt, 2017, p. 483).

The impact of the dyslexia label on academic performance could also be looked at using administrative data, available via the Welsh Government. As highlighted by Parsons and Platt (2017) it would be expected that due to the extra support that is put in place for a child once a diagnosis is received, that academic performance would improve. However, as results from this study show a negative relationship with academic self-concept, it seems necessary to look further at whether this is the case. This will inform us on whether the current systems that are put in place are effective in improving academic performance.

In addition, a vital area for future research is to develop and evaluate a research-led teacher training programme. As the current research shows the benefits of additional training on teachers' understanding of dyslexia, it is important that training is put in place in order to improve the current situation. A new programme needs to be developed, implemented and its results evaluated. Arguably this is needed in both ITE and CPD. Longer term research should explore the benefits of a new programme on both the teacher, and the dyslexic students.

Appendix H sets out a research strategy for shorter and longer-term projects in this area.

11.6 Further dissemination

Results from the teacher survey have been published in *Dyslexia* (Knight, 2018). At the time of writing, three further journal articles are currently in preparation one of which details results of the logistic regression analysis; the second the MCS propensity score matching results; and the third looks in more detail at teacher descriptors through the lens of social representation theory.

Results have also been presented at a number of national and international conferences including the British Educational Research Association (BERA) national conference (Knight, 2017), the University College of Education Teachers (UCET) conference (Knight, 2017) and the European Education Research Association (EERA) conference (Knight, 2018). Attending these educational research conferences has allowed the results to be shared with those who have vested academic, practical and policy-based interest in the area.

Further impact has also been made through sending the initial results of the teacher survey to those who indicated that they would like to know the results at the end of the survey. Those who commented on this were interested to see the results and indicated that they would look for further training on the subject; Appendix I presents the summary that was sent directly to teachers.

11.7 Concluding remarks

This thesis offers unique and novel contributions to the field. Firstly, theoretically, it is the first piece of research to look at dyslexia through the lens of the dyslexic system. Using this framework to understand dyslexia allows a better understanding of the current system. Tomlinson (2012) states that "in the current global recession governments find it easier to focus on individual deficiencies". Applying the conceptual framework of the dyslexia system allows us to see dyslexia as a system in which many interactions are taking place rather than at the individual level alone. Viewing dyslexia in this way shows it as a multifaceted and complex system. Therefore, future work looking into dyslexia needs to consider this framework and understand the individual's environment before drawing conclusions about the nature of

dyslexia. Looking for trends in the system in this way has also allowed conclusions to be drawn about where changes could be made for potential improvement.

Secondly, methodologically, this thesis has contributed to the justification for using large-scale longitudinal data to look at dyslexia. This is the first research that has used the MCS to examine dyslexia specifically. The investigation has been successful and has uncovered important predictors of dyslexia. As a result, this research method has highlighted key areas for future research to investigate these significant results. Furthermore, using large-scale data allowed a dyslexic and non-dyslexic control group to be matched with both groups showing the same likelihood of dyslexia. This has meant that the dyslexic label has been isolated and its effects examined. This highlights the benefits of the use of the propensity score matching (PSM) technique in education research. Furthermore, the teacher survey is the first academic research survey in the UK that looks at the relationship between teacher understandings of dyslexia and their training experiences. This has highlighted a key need for change in the current education system.

Finally, practically, this thesis has also uncovered key areas for change to policy and practice. Three key findings highlight the need for change -- firstly, that the label is unevenly, and unfairly distributed across the population; secondly, that the label has a negative impact on academic outlook; and finally, that teachers hold a stereotypical understanding of the label. These three findings combine to justify a need for change in dyslexia in both the English and Welsh education systems.

To conclude on the same story that introduced this thesis. The Pamela Phelps case suggested that diagnosis of dyslexia would have significantly benefited Ms Phelps, beyond the benefits of additional support alone. However, the results from this research suggest the opposite -- labelling with dyslexia appears to have a significant negative impact on both the individual, and the beliefs of those around them.

Finally, on a personal note, the results suggest that not being diagnosed with dyslexia at a younger age may have had beneficial effects on my own academic development. Findings from this research suggest that being labelled with dyslexia at age 7, 11 or 14 has a negative impact on academic outlook. Therefore, this leads me to question, should my dyslexia

have been identified at a younger age, whether I would be completing my PhD today.

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Appendices

Appendix A- Definitions of Dyslexia

Source	Definition
The Rose Review (2009) *(also approved by the British Dyslexia Association)*	Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. • Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed. • Dyslexia occurs across the range of intellectual abilities. • It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points. • Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia. A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well-founded intervention (Rose, 2009, p.31).
DSM-5 (2013)	*Dyslexia included under the broader title of 'specific learning disorder' which is described as:* Difficulties learning and using academic skills, as indicated by the presence of at least one of the following symptoms that have persisted for at least 6 months, despite the provision of interventions that target those difficulties: 1. Inaccurate or slow and effortful word reading (e.g., reads single words aloud incorrectly or slowly and hesitantly, frequently guesses words, has difficulty sounding out words). 2. Difficulty understanding the meaning of what is read (e.g., may read text accurately but not understand the sequence, relationships, inferences, or deeper meanings of what is read). 3. Difficulties with spelling (e.g., may add, omit, or substitute vowels or consonants). 4. Difficulties with written expression (e.g., makes multiple grammatical or punctuation errors within sentences; employs poor paragraph organization; written expression of ideas lacks clarity). 5. Difficulties mastering number sense, number facts, or calculation (e.g., has poor understanding of numbers, their magnitude, and relationships; counts on fingers to add single-digit numbers instead of recalling the math fact as peers do; gets lost in the midst of arithmetic computation and may switch procedures). 6. Difficulties with mathematical reasoning (e.g., has severe difficulty applying mathematical concepts, facts, or procedures to solve quantitative problems). B. The affected academic skills are substantially and quantifiably below those expected for the individual's chronological age, and cause significant interference with academic or occupational performance, or with activities of daily living, as confirmed by individually administered standardized achievement measures and comprehensive clinical assessment. For individuals age 17 years and older, a documented history of impairing learning difficulties may be substituted for the standardized assessment.

C. The learning difficulties begin during school-age years but may not become fully manifest until the demands for those affected academic skills exceed the individual's limited capacities (e.g., as in timed tests, reading or writing lengthy complex reports for a tight deadline, excessively heavy academic loads).

D. The learning difficulties are not better accounted for by intellectual disabilities, uncorrected visual or auditory acuity, other mental or neurological disorders, psychosocial adversity, lack of proficiency in the language of academic instruction, or inadequate educational instruction.

This is then followed up in the subheading titled 'with impairment in reading':

Note: Dyslexia is an alternative term used to refer to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding, and poor spelling abilities. If dyslexia is used to specify this particular pattern of difficulties, it is important also to specify any additional difficulties that are present, such as difficulties with reading comprehension or math reasoning. (p.67)

ICD-10	*Dyslexia is included under 'Specific reading disorder' which falls into the overall descriptions of 'Specific developmental disorders of scholastic skills'. Specific reading disorder is defined as:* The main feature of this disorder is a specific and significant impairment in the development of reading skills, which is not solely accounted for by mental age, visual acuity problems, or inadequate schooling. Reading comprehension skill, reading word recognition, oral reading skill, and performance of tasks requiring reading may all be affected. Spelling difficulties are frequently associated with specific reading disorder and often remain into adolescence even after some progress in reading has been made. Children with specific reading disorder frequently have a history of specific developmental disorders of speech and language, and comprehensive assessment of current language functioning often reveals subtle contemporaneous difficulties. In addition to academic failure, poor school attendance and problems with social adjustment are frequent complications, particularly in the later elementary and secondary school years. The condition is found in all known languages, but there is uncertainty as to whether or not its frequency is affected by the nature of the language and of the written script. (p.192)
Lyon, Shaywitz, & Shaywitz (2003)	Dyslexia is a specific learning disability that is neuro-biological 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.

Appendix B- Correspondence with Centre for Longitudinal Studies

Hi Cathryn,

It's an interesting question as it has statistical and philosophical implications. The answer depends on which is the target population we would like findings to generalise to. In this case as data are available for only England and Wales I would probably use the country specific weight so the findings generalise to these countries. However, it's not wrong to use the "whole UK" weight as this would imply that the results are generalisable to the whole UK. In practice, the results might not differ that much, but I would be interested to know if they were.

Hope this helps, best wishes,

George

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Appendix C- Correspondence with Freedom of Information Services

England

Query:

>   Under the freedom of information act can you please send a list of
>   all primary, secondary and FE schools in England with the
>   addresses, contact telephone numbers, name of headteacher and an
>   email address for each headteacher.

Response:

>   I have dealt with your request under the Freedom of Information Act
>   2000. A csv file containing data from EduBase as at 21 March 2016
>   is enclosed. The file contains a standard extract of all educational
>   establishments in England. EduBase does not hold individual
>   Headteacher email information, we have supplied you with the
>   school email address.

Wales

Query:

>   Under the freedom of information act can you please send a list of
>   all primary, secondary and FE schools in Wales with the addresses,
>   contact telephone numbers, name of headteacher and an email
>   address for each headteacher.

Response:

>   This information is freely available on our website www.gov.wales/
>   Topics – Education – Schools – Address list of schools

Unweighted Univariate analysis

Respondent Demographics

The first part of the survey asked face sheet information about the respondents. Table 9.1 shows the unweighted demographic information for the eligible respondents (i.e. those within the target population).

Table A1 Unweighted Participant demographics

		N	%
Setting	Primary	1,669	48.8%
	Secondary and post-16	1,447	42.3%
	Special (including PRU)	303	8.9%
Teacher Category	Class Teacher	2,703	77.9%
	Headteacher	307	8.9%
	SENCo	458	13.2%
Sex	Male	650	18.9%
	Female	2,796	81.%
Years Teaching	Currently Training	75	2.2%
	NQT- 5 years	682	19.7%
	5 – 10 years	660	19.1%
	10+ Years	12,043	59%
Country	England	3,281	94.6%
	Wales	178	5.1%
Teacher Training	PGCE	1,840	53.9%
	Teach First/ Schools Direct	72	2.1%
	SCITT (school-centred initial teacher training)	114	3.3%
	Graduate teacher Programme (GTP)	254	7.4%
	Assessment based route to QTS	68	2.0%
	University led undergraduate training (3+ years)	992	29.1%
	Other	74	2.2%
Whether Dyslexic	Dyslexic	247	7.1%
	Not Dyslexic	3,041	88.7%
	Unsure	140	4.1%
Confidence about dyslexia	Extremely confident	544	15.9%
	Somewhat confident	2,093	61.0%
	Somewhat unconfident	740	21.6%
	Extremely unconfident	52	1.5%
Knowledge of dyslexia	I know a lot about dyslexia	535	21.3%
	I know a bit about dyslexia	1,658	66.2%
	I don't know much about dyslexia	310	12.4%
	I know nothing about dyslexia	3	0.1%

Understanding of dyslexia

Appendices

Definition of dyslexia. Participants were asked to "provide a short description of what [they] think dyslexia is". Responses were coded using Frith's (1999) causal model in which she suggests that dyslexia can be described at three separate levels- biological, cognitive and behavioural. If the participants mentioned more that one of these factors in their description they were coded as having a combination (Table A2).

Table A2 Unweighted Definitions of dyslexia

Description code	N	%
Biological	89	3.5%
Cognitive	336	13.3%
Behavioural	1,313	51.9%
Biological and cognitive	13	0.5%
Biological and behavioural	52	2.1%
Conative and behavioural	573	22.7%
Biological, cognitive and behavioural	77	3.0%
Does not exist	1	0.1%
Other	75	3.0%
Total	**2,529**	**100%**

The most mentioned descriptions were behavioural desperations, followed by participants mentioning a combination of both cognitive and behavioural descriptors. The responses were then recoded in order to determine the total number of participants who mentioned or did not mention each type of descriptor.

Table A3 Definitions of dyslexia recoded

	Descriptor Mentioned	
	N	%
Biological	231	9.1%
Cognitive	998	39.5%
Behavioural	2,012	79.7%

Table A3 shows that a large majority of the respondents (79.7%) mentioned behavioural descriptors, followed by cognitive descriptors (39.5%). Biological descriptions were the most uncommon (9.1%).

Furthermore, it was also noted if the participant mentioned the visual factors associated with dyslexia. 430 descriptions mentioned visual factors. This was 12.4% of the descriptions.

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Academic Area Analysis. Teachers were asked "I would like to find out how you think dyslexia affects students in different academic areas. Therefore, please use the scales below to indicate how you believe a person with dyslexia will perform in each area, in comparison to their peers. Select the response that in your experience should be the correct". The participants were required to select the point on a scale ranging from 0 to 100, for each academic subject. Table A4 shows the mean score and standard deviation for each subject area on order of how they were rated.

Table A4 Teachers rating of dyslexic students' performance in comparison to their peers

Subject Area	Mean	Std. Deviation
Spelling	23.06	12.7
Reading	29.3	11.9
Writing	30	12.3
Foreign Languages	35.8	16.5
English Literature	36.9	14.2
History	44	14.6
Geography	47.9	15.2
Science	51.4	15.4
Maths	51.2	16.3
Art	66.2	15.2

Table A4 shows that teachers believed that dyslexic students would perform worse than their peers in all subjects questioned except art, science and maths. Of interested, expected spelling performance *(M= 23.06)* was significantly lower than reading *(M= 29.3), t(2435)=-27.67, p<0.001,* while expected reading performance *(M= 29.3)* was significantly lower than writing *(M= 30), t(2401)=-4.1, p<0001.*

(same significance as weighted)

Teacher training experiences

Quality of teacher training*.* Teachers were asked "In your opinion how well was dyslexia covered on your teacher training programme?" Table A5 shows that a large majority of respondents (71.8%) said that dyslexia was not covered well at all on their teacher training programme.

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Table A5 In your opinion how well was dyslexia covered on your teacher training programme?

Response	N	%
Extremely well	25	1%
Very well	156	6.3%
Slightly well	508	20.5%
Not well at all	1,788	72.2%
Total	**2,477**	**100%**

Additional training. Respondents were also asked if they had received any additional training on top of their initial teacher training. Table A6 shows that the majority of teachers (50.4%) reported that they had no additional training on dyslexia.

Table A6 Have you received any additional training on top of your initial teacher training?

Response	N	%
Yes	1,144	45.6%
No	1,251	49.8%
Unsure	115	4.6%
Total	**2,510**	**100%**

Those that responded 'yes' were prompted to say what type of training that they had received, Table A7 shows the number of responses for each coded category.

Table A7 Additional training type

Response	N	%
In-house training	527	50.3%
External body training	249	23.8%
Lower qualification	158	15.1%
Higher qualification	80	7.6%
Other	34	3.2%
Total	**1,048**	**100%**

The majority of teachers (50.3%) had received in-house training which was any continued professional development (CPD) which was provided in the form of in-house training.

Appendices

Unweighted Bivariate analysis

Respondent demographics and dyslexic understanding

Initial bivariate analysis was conducted between the demographic characteristics of the respondents and whether biological, cognitive or behavioural descriptors were provided. Chi-squared analysis was used in order to determine whether there was any significant difference between the observed and expected value in each cell. Those who responded with 'unsure' or 'other' to any questions were coded as missing for the bivariate analysis.

Setting. There was no significant difference between the teacher setting and whether they gave a biological descriptor when describing dyslexia: $X^2(2)=$ 4.53, p=0.10 *(same significance as weighted)*. However, a significant effect of setting type was found on whether the respondents provided a cognitive response: $X^2(2)=$ 9.03, p=0.01 *(same significance as weighted)*. The number and percentage of teachers who mentioned cognitive factors. Post hoc analysis using adjusted standardised residuals scores showed that there were significantly more primary school teachers than expected (z=3.0), and significantly less secondary and post-16 school teachers (z=2.8) that used cognitive descriptors. There was no significant difference of setting type and whether behavioural descriptors were used: $X^2(2)=$ 4.73, p=0.*09 (same significance as weighted)* and whether a visual descriptor was used $X^2(2)=$ 0.8, p=0.96 *(same significance as weighted)*.

Teacher category. There was no significant difference between the type of teacher that responded and whether they gave a biological descriptor when describing dyslexia: $X^2(2)=$ 0.36, p=0.83 *(same significance as weighted)*. However, a significant effect of the type of teacher was found on whether the respondents provided a cognitive response: $X^2(2)=$ 37.18, p<0.001 *(same significance as weighted)*. Post hoc analysis using adjusted standardised residuals scores showed that significantly less class teachers (z=-5.8), and significantly more headteachers (z=1.7) and SENCos (z=5.6) mentioned cognitive descriptors. There was no significant difference of type

of teacher and whether behavioural descriptors were used: $X^2(2)= 3.12$, p=0.21 *(same significance as weighted)*. However, there was a significant effect of teacher category and whether visual factors were mentioned: $X^2(2)= 30.9$, p<0.001 *(same significance as weighted)*. Class teachers were significantly more likely to mention visual factors (z=5.3), whereas, SENCos were significantly less likely to mention visual factors (z=-5.1).

Sex. There was no significant difference between male and female teachers and whether they gave a biological descriptor when describing dyslexia: $X^2(1)= 0.9$, p=0.35*(same significance as weighted)*. No significant difference between males and females was found in whether a cognitive response was provided: $X^2(1)= 3.75$, p=0.06 *(different significance to weighted)*. In addition, a significant difference was found between male and female teachers in whether or not behavioural descriptors were used: $X^2(1)= 14.9$, p<0.001 *(same significance as weighted)*. Males were significantly less likely to mention behavioural descriptors (z= -3.9) compared females (z=3.9). There was no significant difference between males and females in whether visual factors were mentioned: $X^2(1)= 1.37$, p=0.25 *(same significance as weighted)*.

Years teaching. There was no significant difference of the number of years the respondent had been teaching and whether they gave a biological descriptor when describing dyslexia: $X^2(3)= 0.3$, p=0.39 *(same significance as weighted)*. However, there was a significant effect of years teaching on whether a cognitive descriptor was provided: $X^2(3)= 15.5$, p<0.001 *(same significance as weighted)*. Post hoc analysis showed that those that had been teaching from NQT to 5 years were significantly less likely to give cognitive descriptor of dyslexia (z=-3), whilst those that had been teaching for more than 10 years were more likely to provide a cognitive descriptor of dyslexia (z=3.5). There was no significant difference of the number of years the respondent had been teaching and whether they gave a behavioural descriptor when describing dyslexia: $X^2(3)= 4.49$, p=0.21 *(same significance as weighted)*. However, there was a significant effect of years teaching on whether visual factors were mentioned: $X^2(3)= 18.87$, p<0.001 *(same significance as weighted)*. Those who had been teaching from NQT

to 5 years were more likely to mention visual factors (z=3.6), whereas those who had been teaching for more than 10 years were less likely to mention visual factors (z=-4.1).

Country. There was no significant difference between whether the respondent taught in England or Wales on whether they provided a biological: $X^2(1)$= 0.22, p=0.75 *(same significance as weighted);* cognitive: $X^2(1)$= 1.93, p=0.19 *(same significance as weighted);* behavioural: $X^2(1)$= 1.01, p=0.31 *(same significance as weighted);* or visual: $X^2(1)$= 1.07, p=0.33 description of dyslexia *(same significance as weighted).*

Whether dyslexic. There was a significant difference in teachers who reported to have dyslexia, compared to those who do not have dyslexia, on whether or not they provided a biological description of dyslexia: $X^2(1)$= 9.27, p=0.005 *(same significance as weighted).* Those that have dyslexia (z=3) are significantly more likely to use a biological descriptor than those that do not have dyslexia (z=-3). There was also a significant difference in teachers who reported to have dyslexia, compared to those who do not have dyslexia, on whether or not they provided a cognitive description of dyslexia: $X^2(1)$= 8.46, p=0.004 *(same significance as weighted).* Those that have dyslexia (z=2.9) are significantly more likely to use a cognitive descriptor than those that do not have dyslexia (z=-2.9). Furthermore, there was also a significant difference in teachers who reported to have dyslexia, compared to those who do not have dyslexia, on whether or not they provided a behavioural description of dyslexia: $X^2(1)$= 11.6, p=0.001 *(same significance as weighted).* Those that have dyslexia (z=-3.4) are significantly less likely to use a behavioural descriptor than those that do not have dyslexia (z=3.4). A further of effect of having dyslexia was found in that those with dyslexia (z=-3.5) were significantly less likely to mention visual factors than those without dyslexia (z=3.5): $X^2(2)$= 12.38, p<0.001 *(same significance as weighted).*

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Confidence about dyslexia. Respondents were asked "How confident do you feel in helping a dyslexic student to achieve success". Responses were coded into the binary format 'confident' and 'unconfident'. There was a significant effect of feeling confident on whether the respondent used a biological descriptor: $X^2(1)= 7.31$, $p=0.007$ *(same significance as weighted)*. Those who felt confident were significantly more likely to use a biological descriptor ($z=2.7$) than those who felt unconfident ($z=-2.7$). There was also a significant effect of feeling confident on whether the respondent used a cognitive descriptor: $X^2(1)= 53.78$, $p<0.001$ *(same significance as weighted)*. Those who felt confident were significantly more likely to use a cognitive descriptor ($z=7.3$) than those who felt unconfident ($z=-7.3$). Furthermore, a significant effect of feeling confident was found on whether the respondent used a behavioural descriptor: $X^2(1)= 4.35$, $p=0.04$ *(same significance as weighted)*. Those who felt confident were significantly less likely to use a behavioural descriptor ($z=-2.1$) than those who felt unconfident ($z=2.1$). Finally, those that were confident ($z=-6.2$) were significantly less likely to use a visual descriptor compared to those who were confident ($z=6.2$): $X^2(1)= 37.86$, $p<0.001$ *(same significance as weighted)*.

Knowledge of dyslexia. Respondents were also asked "how much would you say that you know about dyslexia?" Responses were coded into a binary format "knowledge of dyslexia" and "little knowledge of dyslexia. There was a significant effect of having knowledge of dyslexia on whether the respondent used a biological descriptor: $X^2(1)= 21.06$, $p<0.001$ *(same significance as weighted)*. Those who reported that they had knowledge of dyslexia were significantly more likely to use a biological descriptor ($z=4.6$) than those who had little knowledge ($z=-4.6$). There was also a significant effect of having knowledge of dyslexia on whether the respondent used a cognitive descriptor: $X^2(1)= 42.62$, $p<0.001$ *(same significance as weighted)*. Those who reported that they had knowledge of dyslexia were significantly more likely to use a cognitive descriptor ($z=6.5$) than those who had little knowledge ($z=-6.5$). Furthermore, there was a significant effect of having knowledge of dyslexia on whether the respondent used a

behavioural descriptor: $X^2(1)= 4.93$, p=0.026 *(same significance as weighted)*. Those who reported that they had knowledge of dyslexia were significantly less likely to use a behavioural descriptor (z=-2.2) than those who had little knowledge (z=2.2). Finally, there was a significant effect of knowledge of dyslexia on whether visual factors were mentioned: $X^2(1)=$ 9.05, p=0.004 *(same significance as weighted)*. Those, that said that they had knowledge (z=-3) were significantly less likely to use a visual descriptor that those who said that they had no knowledge (z=3)

Training experience by demographics

Setting. There was a significant effect of teacher setting on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(2)= 42.03$, p<0.001 *(same significance as weighted)*. The responses to this question were coded into a binary format of "covered well" and "not covered well". Post-hoc analysis using adjusted standardised residuals showed that primary school teachers were significantly more likely to say it was not covered well (z=6.0), whilst secondary school teachers were significantly more likely to say that it was covered well (z=6.4). There no significant effect of the type of setting that the respondent works in, and whether they had received any additional training on dyslexia: $X^2(2)= 4.04$, p=0.132 (different significance to weighted). There was a significant effect of the respondents setting and they type of extra training that they had received: $X^2(8)= 57.3$, p<0.001 *(same significance as weighted)*. Respondents who worked in primary schools were significantly less likely to have received in-house training (z=-5.2) and were significantly more likely to have received external body training (z=4.7), or have a higher qualification (z=2.4). Respondents from secondary schools were significantly more likely to have received in-house training (z=6.8), and were significantly less likely to have received external body training (z=-5.1) or hold a higher qualification (z=-1.6). Furthermore, those who worked in a special school were significantly more likely to hold a lower qualification (z=2.3).

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Teacher category. There was a significant effect on teacher category on how teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(2)= 7.4$, p=0.025 *(same significance as weighted)*. Post-hoc analysis using adjusted standardised residuals showed that class teachers were significantly more likely to say it was covered well (z=2.7), whilst SENCos were significantly less likely to say that it was covered well (z=-2.4). There was also a significant effect of the type of teacher, and whether they had received any additional training on dyslexia: $X^2(2)= 121.91$, p<0.001 *(same significance as weighted)*. Those that were class teachers were significantly less likely to have received additional training (z=-10.7). Headteachers (z=4) and SENCos (z=9.8) were significantly more likely to have received extra training. In addition to there being a significant of teacher category on whether or not the respondent had received any additional training, there was also a significant effect of teacher category and the type of extra training that they had received: $X^2(6)= 212.62$, p<0.001 *(same significance as weighted)*. Respondents who were class teachers were significantly more likely to have received in-house training (z=13) and were significantly less likely to have received external body training (z=-6.2), have a lower qualification (z=-5.7), or a higher qualification (z=-6.6). Headteachers were significantly less likely to have received in-house training (z=-3.1), and were significantly more likely to have received external body training (z=4). Furthermore, SENCos were significantly less likely to have received in-house training (z=-12.5) but were significantly more likely to have received external body training (z=4.1), hold a lower qualification (z=6.7), or hold a higher qualification (z=7.6).

Sex. There was no significant effect of sex on how teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(2)= 0.13$, p=0.7 (same significance as weighted) . However, there was a significant difference between males and females, and whether they had received any additional training on dyslexia: $X^2(1)= 8.38$, p=0.004 *(same significance as weighted)*. Males were significantly less likely to have received additional training (z=-2.9) than females (z=2.9). In addition to there being a significant of sex on whether

or not the respondent had received any additional training, there was also a significant difference between males and females and the type of extra training that they had received: $X^2(3)= 35.3$, $p<0.001$. Males were significantly more likely to have received in-house training ($z=5.9$) and were significantly less likely to have received external body training ($z=-3.6$) or have a lower qualification ($z=-3.7$).

Years Teaching. There was a significant effect of years teaching on how teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(3)= 35.41$, $p<0.001$ *(same significance as weighted)*. Post-hoc analysis showed that those who had been teaching from 1 to 5 years ($z=4.4$), and 5 to 10 years ($z=2.4$) were significantly more likely to say it was covered well, whilst those who had been teacher for more than ten years were significantly less likely to say that it was covered well ($z=-5.8$). There was also a significant effect of years teaching, and whether the respondents had received any additional training on dyslexia: $X^2(3)= 148.67$, $p<0.001$ *(same significance as weighted)*. Those that were currently training ($z=-2.9$), NQT to 5 years ($z=-10.0$), 5-10 years ($z=-3.0$) were significantly less likely to have received additional training. Those that had been teaching for more that 10 years were significantly more likely to have received extra training ($z=11.4$). In addition to there being a significant of the number of years teaching whether or not the respondent had received any additional training, there was also a significant effect of years teaching and the type of extra training that they had received: $X^2(9)= 28.84$, $p=0.001$ *(same significance as weighted)*. Respondents who had been teaching from NQT to 5 years were significantly less likely to hold a higher qualification ($z=-2.3$). Those that had been teaching for more than 10 years were significantly less likely to have received in-house training ($z=-3.2$) but were significantly more likely to hold a lower ($z=2.6$) and higher ($z=3$) qualification.

Country. There was no significant effect of country on how teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(1)= 3.55$, $p=0.057$ *(different significance to weighted)*. There was no significant effect of

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country, and whether the respondents had received any additional training on dyslexia: $X^2(1)= 1.23$, p=0.28 *(same significance as weighted)*. There was also no significant effect of country on type of extra training that they had received: $X^2(3)= 2.84$, p=0.42 *(same significance as weighted)*.

Teacher Training. There was a significant effect of whether or not the respondent had school based or university based teaching training on teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(1)= 4.77$, p=0.04 *(same significance as weighted)*. Post-hoc analysis showed that those who has university led training were significantly less likely to say it was covered well (z=-2.2), whilst those who had undergone school based teacher training were significantly more likely to say that it was covered well (z=2.2). There was also a significant effect the type of teacher training that the respondent received, and whether the they had received any additional training on dyslexia: $X^2(1)= 11.15$, p=0.001 *(same significance as weighted)*. Those had university-based training were significantly more likely to have received additional training (z=3.3) than those that had received school based training (z=-3.3). However, there was no significant effect of training type and the type of extra training that they had received: $X^2(3)= 1.23$, p=0.75 *(same significance as weighted)*.

Whether Dyslexic. There was no significant effect of whether or not the respondent had dyslexia on how teachers responded to the question "*In your opinion how well was dyslexia covered on your initial teacher training programme*": $X^2(1)= 2.02$, p=0.155 *(same significance as weighted)*. However there was a significant effect of dyslexia on whether the respondent had received any additional training on dyslexia: $X^2(1)= 5.32$, p=0.021 *(same significance as weighted)*. Those had dyslexia were significantly less likely to have received additional training (z=-2.3) than those did not have dyslexia (z=2.3). There was also no significant effect of dyslexia and the type of extra training that they had received: $X^2(3)= 0.62$, p=0.892 *(same significance as weighted)*.

Confidence about dyslexia. There was a significant effect of how teachers answered the question "how confident do you need in helping a dyslexic

person achieve success" on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 26.89$, p<0.001 *(same significance as weighted)*. Post-hoc analysis showed that those who felt confident were significantly more likely to say it was covered well ($z=5.2$) than those that felt unconfident ($z=-5.2$). There was also a significant effect of confidence, on whether the respondents had received any additional training on dyslexia: $X^2(1)=$ 183.59, p<0.001 *(same significance as weighted)*. Those that were confident were significantly more likely to have received additional training ($z=13.5$) than those that were unconfident ($z=-13.5$). In addition to there being a significant effect of confidence on whether or not the respondent had received any additional training, there was also a significant difference between those that were and were not confident and the type of extra training that they had received: $X^2(3)= 36.43$, p<0.001 *(same significance as weighted)*. Respondents who were confident were significantly less likely to have had in-house training ($z=-5.8$), and significantly more likely to have had external body training ($z=2.2$), hold a lower qualification ($z=3.3$) and hold a higher qualification ($z=2.8$) than those who reported to be unconfident.

Knowledge of dyslexia. There was a significant effect of how teachers answered the question "how much would you say that you know about dyslexia" on how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 24.37$, p<0.001 *(same significance as weighted)*. Post-hoc analysis showed that those who reported having knowledge of dyslexia significantly more likely to say it was covered well ($z=4.9$) than those who reported little knowledge ($z=-4.9$). There was also a significant effect of knowledge, and whether the respondents had received any additional training on dyslexia: $X^2(1)= 149.72$, p<0.001 *(same significance as weighted)*. Those that had knowledge were significantly more likely to have received additional training ($z=12.2$) than those that had little knowledge ($z=-12.2$). In addition to there being a significant effect of knowledge on whether or not the respondent had received any additional training, there was also a significant difference between those that had knowledge and those that had little

knowledge, and the type of extra training that they had received: $X^2(3)=$ 19.65, p<0.001 *(same significance as weighted)*. Respondents who reported knowledge of dyslexia were significantly less likely to have had in-house training (z=-4.4), and significantly more likely to have had external body training (z=2.0) and hold a lower qualification (z=2.7) than those who reported little knowledge.

Training by description codes

It is also interesting to investigate how training influenced whether or not a biological, cognitive, behavioural or visual description of dyslexia was given when the respondents were asked to provide a short description of dyslexia.

Biological. There was a significant effect of whether biological descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)=$ 9.1, p=0.003 *(same significance as weighted)*. Post-hoc analysis showed that those who used a biological descriptor were significantly more likely to say it was covered well (z=3.0) than those who did not mention a biological descriptor (z=-3.0). However, there was no significant effect of receiving any additional training, and whether the respondents mentioned the biological aspects associated with dyslexia: $X^2(1)=$ 0.01, p=0.9 *(same significance as weighted)*. There was no significant effect of the type of extra training received and whether a biological descriptor was used: $X^2(3)=$ 4.4, p=0.22 *(different significance to weighted)*.

Cognitive. There was no significant effect of whether cognitive descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)=$ 0.24, p=0.63 *(same significance as weighted)*. However, there was a significant effect of receiving any additional training, and whether the respondents mentioned the cognitive aspects associated with dyslexia: $X^2(1)=$ 46.82, p<0.001. Those that had received extra training were significantly more likely to use a cognitive descriptor (z=6.8) than those that did not (z=-6.8). Furthermore, there was also a significant effect of the type

of extra training received and whether a cognitive descriptor was used: $X^2(3)= 27.1$, p<0.001 *(same significance as weighted)*. Respondents who used a cognitive descriptor were significantly less likely to have had in-house training (z=-4.5), and significantly more likely to have a lower qualification (z=4.3).

Behavioural. There was no significant effect of whether behavioural descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 0.08$, p=0.92 *(same significance as weighted)*. There was a significant effect of receiving any additional training, and whether the respondents mentioned the behavioural aspects associated with dyslexia: $X^2(1)= 5.49$, p=0.021 *(same significance as weighted)*. Those that had received additional training were significantly less likely to give a behavioural descriptor (z=2.3) than those who had not received additional training (z=-2.3) Furthermore, there was also no significant effect of the type of extra training received and whether a behavioural descriptor was used: $X^2(3)= 0.01$, p=1 *(same significance as weighted)*.

Visual. There was a significant effect of whether visual descriptors were used and how teachers responded to the question "In your opinion how well was dyslexia covered on your initial teacher training programme": $X^2(1)= 4.08$, p=0.043 *(same significance as weighted)*. Those that mentioned visual descriptors (z=2.0)were more likely to say that it was covered well than those who did not mention visual descriptors (z=-2.0). There was also a significant effect of receiving any additional training, and whether the respondents mentioned the visual aspects associated with dyslexia: $X^2(1)= 20.03$, p<0.001 *(same significance as weighted)*. Those that had received extra training were significantly less likely to use a visual descriptor (z=-4.5) than those that did not (z=4.5). Finally, there was also a significant effect of the type of extra training received and whether a visual descriptor was used: $X^2(3)= 14.17$, p=0.003 *(same significance as weighted)*. Respondents who used a visual descriptor were significantly more likely to have had in-house training (z=3.9), and significantly less likely to have a lower qualification (z=-2.9).

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Appendix E- Survey Invitation

English:

Dear [School Name],

I am a PhD student at Cardiff University. I am conducting research into teachers' understandings of dyslexia. A significant amount of research has suggested that children with dyslexia do not have great confidence in their academic ability and consequently suffer from a low academic self-concept. I believe that well informed teachers could help in alleviating this problem. Therefore, I am interested in what teachers currently know about dyslexia, and what could be done to give teachers more support with students with dyslexia. I have created a short online survey for teachers to give their opinions on these subjects. I would be really grateful if you could forward the following link to the teaching staff at [school name]. It is a short survey and should only take around 5 to 10 minutes to complete.

[Survey link]

Your cooperation in this will be highly beneficial both to my own research and to research in this area.

Thank-you for your time,

Cathy Knight

Welsh:

Annwyl [Enw Ysgol],

Myfyrwraig PhD ym Mhrifysgol Caerdydd ydw i. Rwy'n ymchwilio i'r hyn y mae athrawon yn ei ddeall am ddyslecsia. Mae llawer o ymchwil wedi awgrymu nad oes gan blant sydd â dyslecsia lawer o hyder yn eu gallu academaidd. Rwy'n credu y gall athrawon sy'n deall dyslecsia helpu i leddfu'r broblem. Felly, mae gennyf ddiddordeb yn yr hyn mae athrawon yn ei wybod am ddyslecsia ar hyn o bryd, a beth ellir cael ei wneud i roi rhagor o gefnogaeth i athrawon sy'n dysgu plant dyslecsig. Rwyf wedi creu arolwg ar-lein er mwyn i athrawon allu roi eu barn am ddyslecsia. Byddaf yn ddiolchgar iawn pe gallech anfon y ddolen i'r staff addysgu yn [enw ysgol], School. Mae'n arolwg byr a dim ond tua 5 i 10 munud y bydd yn ei gymryd i'w gwblhau.

[Survey link]

Bydd eich cydweithrediad yn fuddiol iawn i fy ymchwil i yn ogystal ag ymchwil yn y maes hwn yn gyffredinol.

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Diolch am eich amser,
Cathy Knight

Appendix F- Teacher Survey Questions

Thank-you for agreeing to take part in this survey on dyslexia.

The results of this survey will be used in order to investigate what teachers think about dyslexia and what experiences they have had working with students with dyslexia.

The survey should take around 5-10 minutes to complete.

The responses you give will be anonymous and confidential. You may withdraw your responses from the study at any time. At the end of the survey you will be asked if you would like to receive a summary of the findings of this project. If you would like to know the findings, then please provide your email address. This is optional and, if provided, will be kept confidential.

If you have any questions or wish to withdraw your data, feel free to contact me at: **KnightCS1@cardiff.ac.uk**

1. In which setting do you teach?
    a. Primary School
    b. Secondary School
    c. Further education (Post 16)
    d. Special school
    e. Other _____

2. Are you
    a. Headteacher
    b. Class teacher
    c. Teaching assistant
    d. SENCo
    e. Other _____

3. Are you
    a. Male
    b. Female

4. How many years have you been teaching?
    a. Currently training
    b. NQT- 5 years
    c. 5-10 years
    d. 10+ years.

5. In which country do you teach?
    a. England
    b. Wales
    c. Other

6. (Wales only) Do you teach in a

      a. Welsh medium establishment
      b. English medium establishment
      c. Bilingual establishment
      d. Other

7. What form of teacher training did you complete/ are you currently completing?
      a. PGCE
      b. Teach First/ Schools Direct
      c. School-centred initial teacher training (SCITT)
      d. Graduate teacher programme (GTP)
      e. Assessment based route to QTS
      f. University-led undergraduate training (3+ years)
      g. Other

8. Do you have dyslexia?
      a. Yes
      b. No
      c. Unsure

9. How confident do you feel in helping a dyslexic student achieve success?
      a. Extremely confident
      b. Somewhat confident
      c. Somewhat unconfident
      d. Extremely unconfident

10. "How much would you say you know about dyslexia?"
      a. I know a lot about dyslexia
      b. I know a bit about dyslexia
      c. I don't know much about dyslexia
      d. I know nothing about dyslexia

11. Please provide a short description about what you think dyslexia is.
      (Multi-line text box)

12. I would like to find out how you think dyslexia affects students in different academic areas. Therefore, please use the scales below to indicate how you believe a person with dyslexia will perform in each area, in comparison to their peers. Select the response that in your experience should be the correct answer.
      a. Maths
      b. Reading
      c. Science
      d. Writing
      e. Spelling
      f. Art
      g. English Literature
      h. History
      i. Geography
      j. Foreign languages

(N.B Subjects presented in a random order)

13. In your opinion how well was dyslexia covered on your teacher training programme?
    a. Extremely well
    b. Very well
    c. Slightly well
    d. Not well at all

14. Have you received any formal training on dyslexia (on top of any initial teacher training)? If Yes, what training have you received"
    a. Yes *(text box)*
    b. No
    c. Unsure

15. (if yes) What additional training have you received?
    (Short answer text box)

Thank-you very much for taking part in this survey. The results that you have provided will contribute significantly to my research. If you would like to receive a summary of the results of this survey please provide your email address below.

(Short answer text box)

Appendix G- Ethical Guidelines

Informed Consent. The email sent to all schools contained information about the nature of the study and what it involved, including the topic of study and information about the length of time it would take to complete. After clicking on the link further information about the study was also provided. The respondent had the choice whether or not to take part in the study as no incentives were offered. Therefore, by taking part in the study, consent from the respondents was assumed.
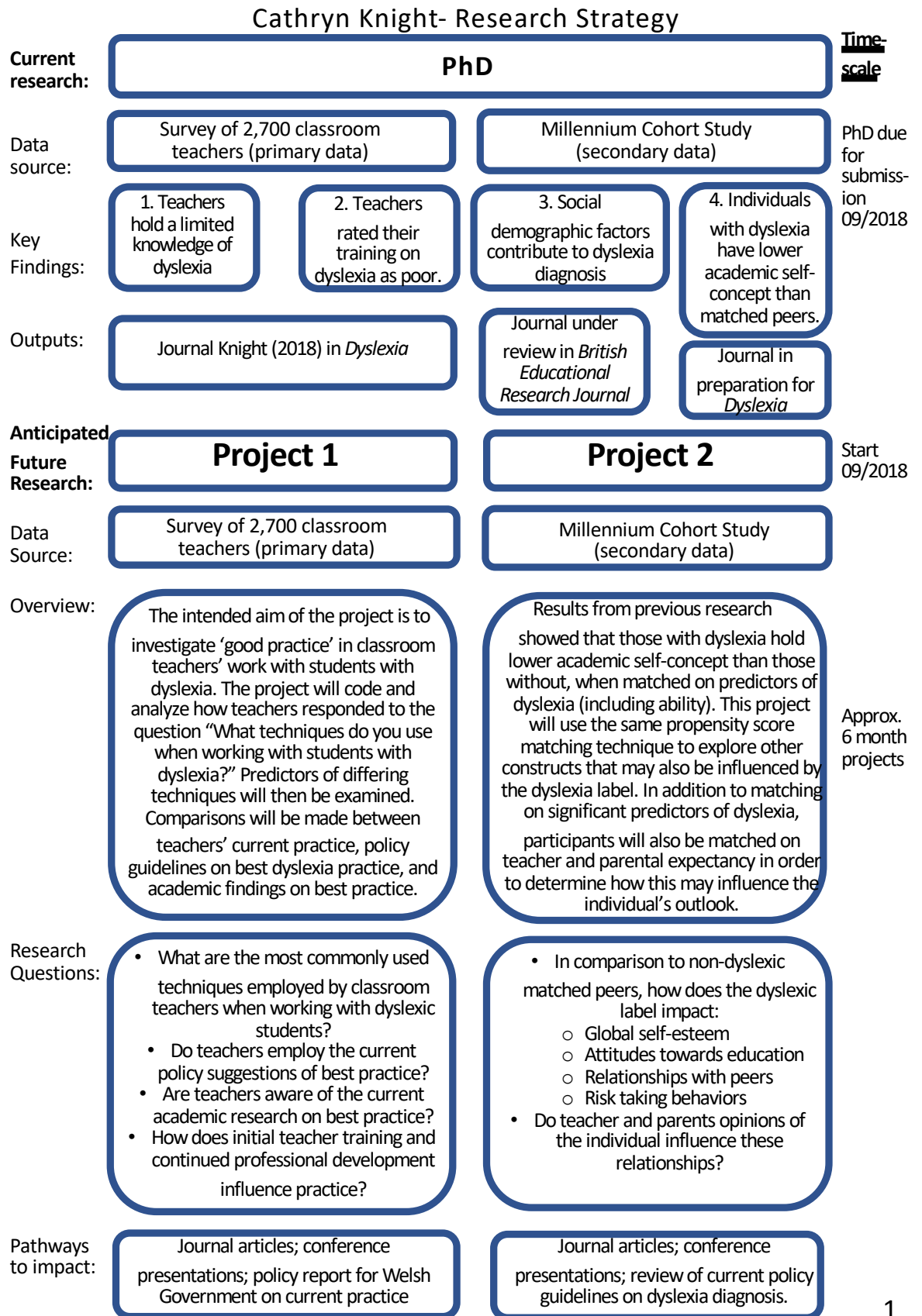
Right to Withdraw. Upon clicking on the link to the study, information was given to the respondent informing them of their right to withdraw. This information contained the researcher's contact details, should the respondent wish to remove their results from the study in the future. Furthermore, the original email was sent using the relevant email address to reply to should the participant wish to withdraw, or have any other questions or concerns following the survey.

Confidentiality. The respondents were not asked for any personal information which would make them identifiable to the researcher. In addition to this they were informed prior to starting the survey, that the results they gave would be anonymous and that they would be kept confidential. However, they were asked to provide an email address should they want to know the key findings from the research. They were informed that this would be optional, and, should it be provided, it would not be passed on, or used to identify either them or their school. In the data file these email addresses have been encrypted so that the answers cannot be associated with a particular email address.

Deceit. No deceit was involved in the research. Respondents were told that the study was investigating "what teachers think about dyslexia and what experiences they have had working with students with dyslexia". The study did not contain any questions that were irrelevant to this topic.

Physical or Psychological Harm. The questionnaire was designed to look at teachers' understandings of dyslexia. It did not question or probe for deeper feelings or sensitive information. Therefore, there was no outwardly obvious risks of psychological harm to respondents. As participation was voluntary and optional, teachers who felt this topic was of a sensitive nature could choose not to take part. They were also told that they could withdraw from the study at any time.

Appendices

Cathryn Knight- Research Strategy

			Time-scale
Current research:	**PhD**		**Time-scale**

Data source:	Survey of 2,700 classroom teachers (primary data)	Millennium Cohort Study (secondary data)	PhD due for submiss-ion 09/2018

Key Findings:	1. Teachers hold a limited knowledge of dyslexia	2. Teachers rated their training on dyslexia as poor.	3. Social demographic factors contribute to dyslexia diagnosis	4. Individuals with dyslexia have lower academic self-concept than matched peers.

Outputs:	Journal Knight (2018) in *Dyslexia*	Journal under review in *British Educational Research Journal*	Journal in preparation for *Dyslexia*

Anticipated Future Research:	**Project 1**	**Project 2**	Start 09/2018

Data Source:	Survey of 2,700 classroom teachers (primary data)	Millennium Cohort Study (secondary data)	

Overview:	The intended aim of the project is to investigate 'good practice' in classroom teachers' work with students with dyslexia. The project will code and analyze how teachers responded to the question "What techniques do you use when working with students with dyslexia?" Predictors of differing techniques will then be examined. Comparisons will be made between teachers' current practice, policy guidelines on best dyslexia practice, and academic findings on best practice.	Results from previous research showed that those with dyslexia hold lower academic self-concept than those without, when matched on predictors of dyslexia (including ability). This project will use the same propensity score matching technique to explore other constructs that may also be influenced by the dyslexia label. In addition to matching on significant predictors of dyslexia, participants will also be matched on teacher and parental expectancy in order to determine how this may influence the individual's outlook.

Approx. 6 month projects

Research Questions:	• What are the most commonly used techniques employed by classroom teachers when working with dyslexic students?
	• Do teachers employ the current policy suggestions of best practice?
	• Are teachers aware of the current academic research on best practice?
	• How does initial teacher training and continued professional development influence practice?
		• In comparison to non-dyslexic matched peers, how does the dyslexic label impact:
		  o Global self-esteem
		  o Attitudes towards education
		  o Relationships with peers
		  o Risk taking behaviors
		• Do teacher and parents opinions of the individual influence these relationships?

Pathways to impact:	Journal articles; conference presentations; policy report for Welsh Government on current practice	Journal articles; conference presentations; review of current policy guidelines on dyslexia diagnosis.

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Anticipated Future Research (cont.):	**Project 3**	**Project 4**	Time-scale
Potential funding source:	TBC	ESRC Secondary Data Analysis Initiative (SDAI)	Apply for funding 09/2018
Data Source:	Action research with trainee teachers	Administrative data (Administrative Data Research Centre (ADRN))	
Overview:	This project will build upon findings from previous research that has found that current initial teacher training programmes do not offer enough support on working with students with dyslexia. Therefore, alongside Swansea University's plans of creating an ITE programme, I anticipate that this project will devise a research based intervention designed to help trainee teachers to work most effectively with students with additional learning needs (ALN). Teachers will be followed up after the course to assess the long term impact of the intervention.	Previous research has shown negative effects of the dyslexia diagnosis on academic self-concept. However, to date, no research has been conducted that investigates the impact of diagnosis on academic outcomes. This project will use administrative data from Wales in order to investigate the differences in academic trajectory before and after dyslexia diagnosis.	Approx. 1 year projects
Research Questions:	• How does teachers knowledge of ALN change before and after a research based intervention? • How does this compare to trainee teachers who have not received this intervention? • Does the intervention have a lasting impact on teachers' interactions with dyslexic students (longitudinal aspects) • Does the intervention positively impact students with ALN?	• How does diagnosis of Additional Learning Needs (ALN) impact academic outcomes? • How does the type of ALN diagnosis impact academic outcomes. • How does the School Action and School Action Plus system impact academic outcomes?	Yearly follow-ups (Project 3)
Pathways to impact:	The development of an effective ITT programme that could be implemented countrywide.	Journal articles; conference presentations; review of current School Action policy.	

Project 5: As further data is released from the Millennium Cohort Study I would like to repeat research from my PhD and Project 2 in order to investigate the impact of the cohort members ongoing development on the results. Furthermore, as there is likely to be an increased number of cohort members diagnosed with dyslexia in future sweeps, I would like to match the data with the National Pupil Database to further investigate the impact of dyslexia on academic performance.

Ongoing

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Appendix I- Summary Sent to Teachers

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Thank-you for taking part in my research project on dyslexia. Data collection was very successful. A total of 4,135 teachers started the survey with 2,770 completing the whole survey. Below is a summary of the key findings followed by a summary of the data. If you have any questions, feel free to contact me on KnightCS1@cardiff.ac.uk

KEY FINDINGS (See below for a breakdown of the findings)

- Teachers were more likely to describe dyslexia using behavioural descriptors rather than biological and cognitive descriptors.
- 17% of teachers defined dyslexia as a visual problem however this has been largely proven as inconclusive.
- The majority for teachers (67.1%) said that dyslexia was not covered well at all on their initial teacher training programme.
- 45% of teachers had received some form of extra training on the area of dyslexia.
- Those who had extra training were significantly more likely to report that they had knowledge of dyslexia than those who had not had extra training.
- Those who had extra training were significantly more likely to say that *"I am unsure how to best help a student with dyslexia"* was untrue.
- Those that had received extra training were significantly more likely to say that they were confident in helping a dyslexic student achieve success.
- Those that had received extra training were significantly less likely to mention the visual problems with dyslexia.
- Those who had received extra training were significantly more likely to give a cognitive description of dyslexia and significantly less likely to give a behavioural description.

MAIN CONCLUSIONS

- Many teachers do not seem to be aware of the cognitive and biological aspects of dyslexia and therefore, teachers seem to hold fairly stereotypical ideas about what dyslexia is.
- Teachers hold misconceptions that dyslexia is a visual problem.
- Extra training significantly improves teachers' confidence and knowledge of dyslexia and should be given to teachers where possible.

Appendices

TEACHER DESCRIPTIONS

Teachers were asked to "provide a short description of what [they] think dyslexia is". I went through the descriptions and coded them using Frith's (1999) causal model of in which she suggests that dyslexia can be described at three separate levels- biological, cognitive and behavioural. Descriptions that were coded as biological gave descriptors about the brain, neurological differences or genetics being the cause of the dyslexic symptoms. Descriptions were coded as cognitive if they mentioned the cognitive processes associated with dyslexia, such as processing differences, issues decoding, and memory problems. Finally, descriptions that were coded as behavioural mentioned the outward symptoms of dyslexia, mainly issues with reading, writing and spelling. If the participants mentioned more that one of these factors in their description, they were coded as having a combination (*see Figure 1).*

Figure 1- *Bar chart to show percentage of coded responses*
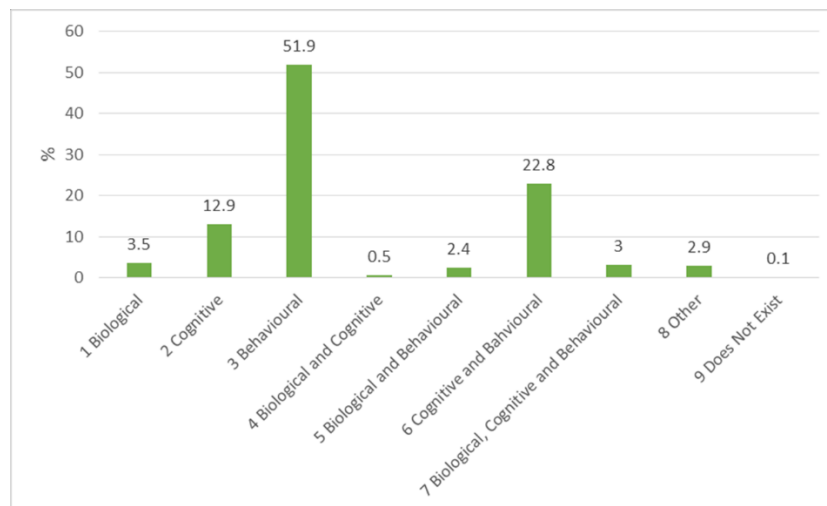
The most mentioned descriptions were behavioural desperations, followed by participants mentioning a combination of both cognitive and behavioural descriptors.

I then recoded the responses in order to get the total number of participants who mentioned, or did not mention, each type of descriptor.

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**Figure 2-** *Pie chart to show number of biological descriptors used*

Whether biological descriptors mentioned

9.40%

90.60%

■ Mentioned- Biological   ■ Did not mention- Biological
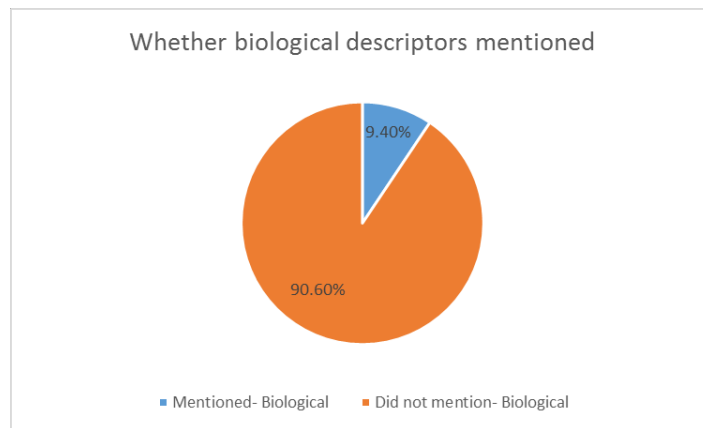
Only 9.4% of participants mentioned biological descriptors.

Figure 3- *Pie chart to show number of cognitive descriptors used*

Whether cognitive descriptors mentioned

39.20%

60.80%

■ Mentioned- Cognitive   ■ Did not mention- Cognitive
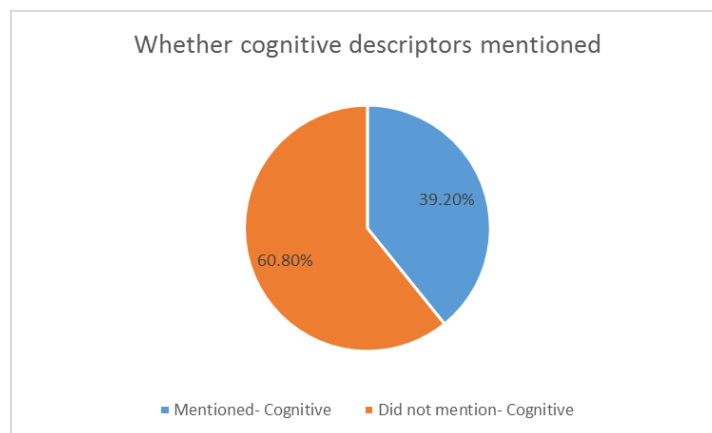
39.2% of participants mentioned cognitive descriptors.

Figure 4- *Pie chart to show number of behavioural descriptors used*

Whether cognitive descriptors mentioned

20.00%

80.00%

■ Mentioned- Behavioural   ■ Did not mention- Behavioural
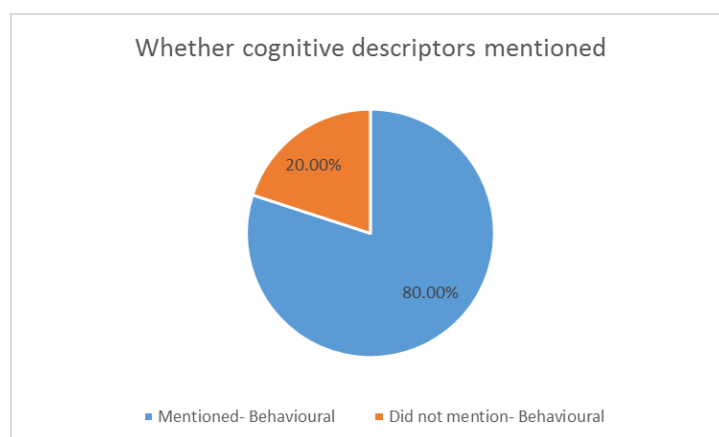
A large majority of the participants (80%) mentioned behavioural descriptors.

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17% of teachers defined dyslexia as a visual problem.

This has been largely proven as inaccurate and is not included in any formal definition of dyslexia. Many children reverse letters when learning to read and write, regardless of the presence of dyslexia. If it persistent it may be a red flag, however, you can be dyslexic and have not visual problems and you can have visual problems and not be dyslexic.

Stein et al. (2000) state that "the visual magnocellular impairment in most dyslexics is mild, and all researchers would agree that it is not found in every dyslexic". Therefore, whilst visual deficits can co-occur with dyslexia, it is not the primary deficit.

TRAINING

Teachers were asked "In your opinion how well was dyslexia covered on your teacher training programme?" Figure 5 shows that the majority for teachers *(67.1%)* said that it was not covered well at all.

Figure 5- *Pie chart to show teachers opinions on their teacher training*
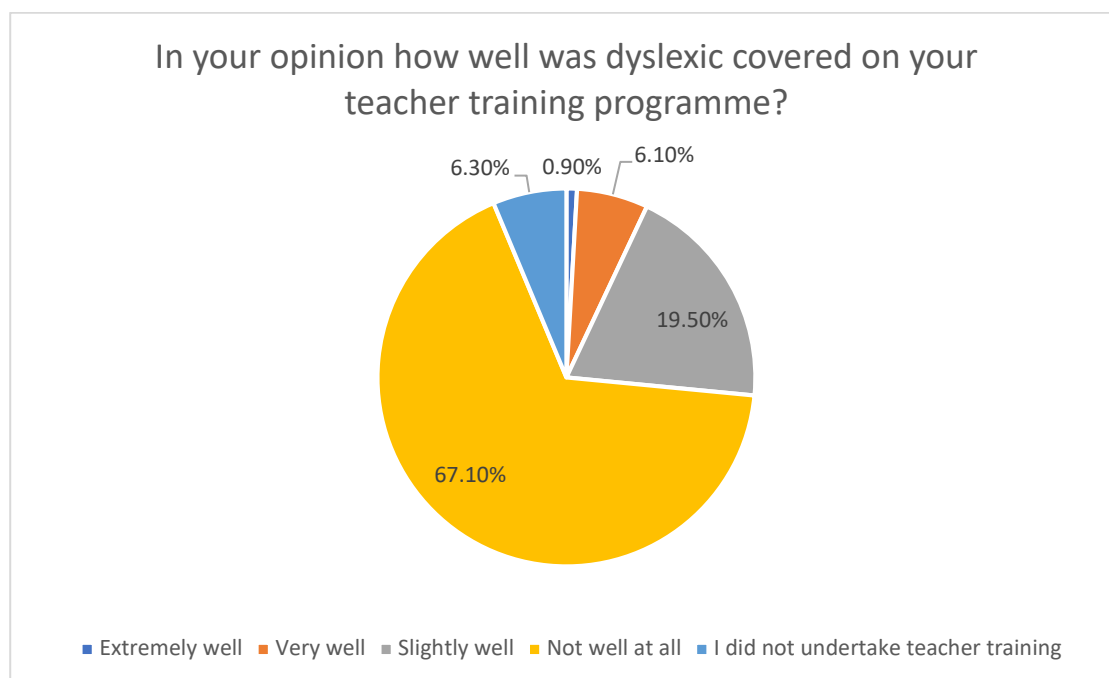
Teachers were asked whether or not they had received any extra training on dyslexia. Figure 6 shows that 49.8% of teachers surveyed had not received any extra training on dyslexia.

Figure 6- *Bar chart to show extra training*
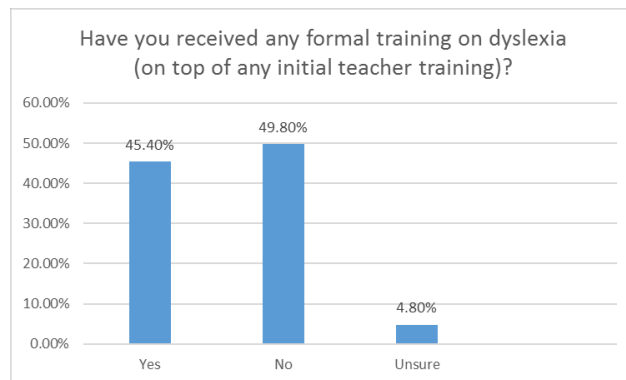
Those who had received extra training were asked what type of training they had received. The responses were coded into five categories:

1- In-house training (e.g. CPD, school inset) *(48.6%)*
2- Out of house training (e.g. training from external bodes such as the British Dyslexia Association or Dyslexia Action) *(24.5%)*
3- Lower qualification (those who has received a qualification around the area of dyslexia such as and NVQ or diploma) *(16.4%)*
4- Higher qualification (those who had a Masters qualification around the area of dyslexia or were a qualified SENCo) *(7.3%)*
5- Other *(3.2%)*

Figure 7- *Bar chart to show type of extra teacher training*
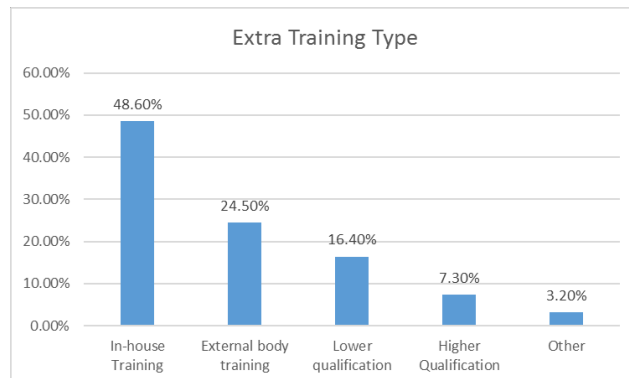
Extra training had a significant effect on the knowledge that the teacher said that they had of dyslexia. **Those who had extra training were significantly more likely to report that they had knowledge of dyslexia than those who had not had extra training** $X2 (1, N = 2742) = 167.79, p < 0.001$.

Extra training also had a significant effect on how the participant responded to the statement "I am unsure how to best help a student with dyslexia" $X2 (1, N =$

2735) = 335.93, p <0.001. **Those who had extra training were significantly more likely to say that this statement was untrue.**

Extra training had a significant effect on how teachers responded to the statement "How confident do you feel in helping a dyslexic student achieve success?" X2 (1, N = 2724) = 205.75, p <0.001. **Those that had received extra training were significantly more likely to say that they were confident.**

Whether or not the teachers had extra training had a significant effect on whether they mentioned visual factors in their description of dyslexia X2 (1, N = 2614) = 22.77, p <0.001. **Those that had received extra training were significantly less likely to mention the visual problems with dyslexia.**

Extra training also affected the description that the teachers gave. **Those who had received extra training were significantly more likely to give a cognitive response and significantly less likely to give a behavioural response** (see figures 8 and 9).

Figure 8- *Bar chart to show the effect of extra training on giving a cognitive descriptor*
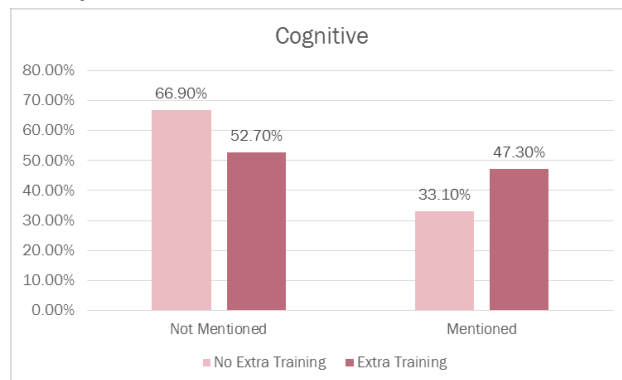
Figure 9- *Bar chart to show the effect of extra training on giving a behavioural descriptor*
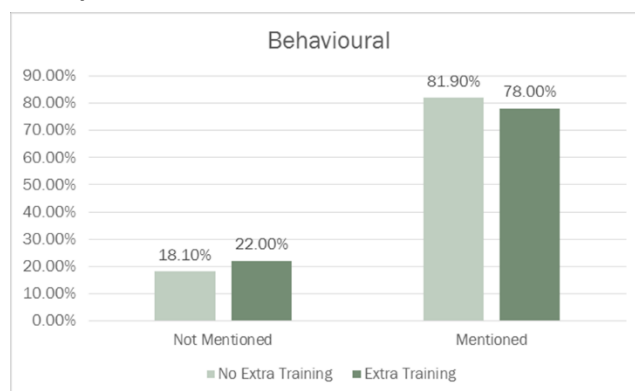
In the above area, those who had received only 'in-house training' were significantly less positive than the other training types:

- Those who had received only in-house training were significantly more likely to claim that they had little knowledge of dyslexia.
- Those who had received only in-house training were significantly more likely to say that statement "I am unsure how to best help a student with dyslexia" was true.
- Those who had received only in-house training were significantly more likely to say they were unconfident in helping individuals with dyslexia achieve academic success.
- Those who had received only in-house training were significantly less likely to give a cognitive descriptor.