

**How Altering Letter Size and Spacing in Text can Affect Reading Speed and Accuracy for
Students with Dyslexia**

Emma Jane Rawlinson

Swansea Metropolitan

University of Wales Trinity Saint David

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Abstract

This study was undertaken to establish the significance of the visual system in ongoing reading difficulties experienced by my students with dyslexia. Historically, there has been a general belief that much of the difficulty results from weaknesses in phonological processing skills; however, my own experience as a dyslexia assessor and tutor has made me curious as to the magnitude of the visual aspects during the process of reading. This is essential in understanding how best to focus support. Whilst many experts remain of the belief that teaching explicit phonics instruction is the answer, this can be of little help when students come across irregular words (common in the English language) and which cannot simply be sounded out. This is where the visual skills are additionally relied upon for the task of reading.

The reading performance of 10 dyslexic participants, studying in Further Education were analysed in terms of reading rate and accuracy.

Results found the participant group read faster and with improved word accuracy as a result of increased spacing and font size. Whilst errors were reduced in the visual aspects they were also reduced across other areas (including the phonological aspects). The findings of this study propose that altering the perceptual properties of text may assist both visual and phonic skills to work together, benefitting reading performance.

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed:  (candidate)

Date: 26.05.18

STATEMENT 1

This dissertation is being submitted in partial fulfilment of the requirements for the degree of: MA (Ed)

Signed:  (candidate)

Date: 26.05.18

STATEMENT 2

This dissertation is the result of my own independent work / investigation, except where otherwise stated.

Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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I hereby give consent for my dissertation, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

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Chapter One: Introduction to the study

Introduction

The following chapter provides an introduction to the study. Firstly, it does this by giving a context to the research, with a summary of my role as a specialist teacher and assessor, then in describing how this has prompted the rationale for this research. Ongoing difficulties with reading that my own students with dyslexia encounter are described in this chapter and form the basis for this research study. The aims of the study are outlined and these will map through the chapters that follow. There are three main aims given; the first will provide an historical understanding of language-based and visual-based processing difficulties that associate with dyslexia. The second of my aims seeks to identify the factors (especially those which are visual-based), that may be thought to cause, or influence reading difficulties. The third aim looks practically at changing the aesthetics of a page of text, in terms of altering the font and spacing. The results of this research are then evaluated to see what effect has been had on reading speed and reading accuracy of students with dyslexia.

Professional background and context

For the past few years I have worked full-time as a Dyslexia Support Tutor in a local college of further education, whilst training to gain my professional accreditation as a specialist teacher. For the purposes of this study my place of employment will remain anonymous and instead this will be referred to as my 'Organisation'. On completion of my Master's Level assessment qualification, I was able to apply for and receive my PATOSS SpLD (Specific Learning Difficulties) Practicing Certificate, together with membership of PATOSS (The Professional Association of Teachers of Students with Specific Learning Difficulties). The Practicing Certificate is an essential requirement for specialist teachers to demonstrate their professional knowledge and competence in assessment, teaching and Specific Learning Difficulties. In order to maintain the Practicing Certificate this requires Continuing Professional Development (CPD), including attending training with PATOSS and also by undertaking a certificate renewal process every three years.

In the academic year of 2017 I took on the role of Dyslexia/SpLD Coordinator within my organisation. As such, I am now the main point of contact for staff and students on matters relating to dyslexia and other specific learning difficulties. Within this role I carry out regular awareness training sessions for tutors and trainee teachers, in addition to acting as mentor to a new dyslexia tutor on my team. As well as these responsibilities, my day to day role involves the ongoing support of FE (Further Education) and HE (Higher Education) students in my organisation who have dyslexia or other specific learning difficulties, dyslexia screening and exam provision assessments, undertaking full diagnostic assessments for those students moving onto Higher

Education courses - a full diagnostic report is required for students to apply for the Disabled Student's Allowance (DSA), allowing them to access a package of funded support at university level. Also, as a qualified Irlen screener part of my role involves identifying visual stress difficulties in my students which are often found to co-occur with specific learning difficulties such as dyslexia. My own training in being able to screen visual stress difficulties was provided by the Irlen organisation in using the Irlen Method (a diagnostic tool to identify symptoms and determine an overlay colour to suit the individual). It should be acknowledged however that this is a commercial organisation and therefore the preferred term of 'visual stress', as recommended by PATOSS is used to refer to such difficulties throughout the remainder of this report. Visual stress can best be described as being a 'perceptual processing disorder' and refers to how the brain processes visual information it receives (Irlen Institute, 2017). Visual stress difficulties can affect tracking or orientation skills when reading, or more commonly affect speed of processing of visual information, such as that which is text-based. Visual processing difficulties and namely a weakness in processing speed is acknowledged as being characteristic to a dyslexia definition (British Dyslexia Association (BDA), 2007). A slow processing speed is thought to have the greatest impact on a student's ability to read efficiently (Jones and Kindersley, 2013).

I support private clients with dyslexia tutoring, employees in the workplace through Access to Work (a Government-funded support programme supporting disabled people, such as those with dyslexia), as well as carrying out full diagnostic assessments and screeners for visual stress. This contributes to my experience and ongoing professional development.

Rationale

Experience gained through working with and assessing students with visual stress difficulties, in addition to those with dyslexia, has ignited an ongoing interest in the visual characteristics associated with a profile of dyslexia and how these might affect visual processing ability. I have been surprised at the regularity of difficulty that seems to arise from the visual aspects and have registered a pattern to emerge through the kinds of comments that my students make. They repeatedly refer to a page of text as appearing to look 'crowded'. I also observe students to place their finger on a page to try to physically separate out the areas. These students often prefer to have information presented pictorially, such as with mind-maps and diagrams, as opposed to receiving documents of a 'wordier' format. Their difficulties appear to be exacerbated when the text is more academic in its presentation, greater in volume, when the font is small, or there is less spacing given around the words. These difficulties do not only seem confined to pages of text but also other types of 'busy' pages, such as those of a mathematical or science-based layout.

For those of my students who have been diagnosed as having visual stress difficulties, this can, in many cases be remedied through placing a special coloured overlay (plastic sheet) over the top

of a page of text. This is thought to help to make the text easier to process and to help in alleviating physical signs that can be associated with visual stress. An example of these signs might be in experiencing frequent headaches, eye strain or tiredness that result from the brain having to work harder to visually process the given information. Essentially the overlay works by altering the aesthetics of the page. Whilst this can be effective for those with visual stress difficulties, not all students with dyslexia have visual stress symptoms, therefore dismissing use of an overlay in this instance, however still acknowledging there to be ongoing difficulties connected with processing when reading.

Having previously carried out a research study into phonics intervention with adults, in addition to looking to my own experiences working with my students, I have found any reading gains to be made from teaching phonics to be inconsistent and difficult to predict. Therefore, this has led to my considering alternative methods of intervention as a strategy and aid to reading.

Historically, a somewhat narrow research focus has resulted in a view that has become widely accepted in the field of dyslexia; that of phonological weaknesses being at the core of a dyslexic profile. As a result, phonological deficits are considered to be primarily responsible for ongoing difficulties experienced with reading. Whilst not aiming to dispute the relevance of the phonological skills to the process of reading, such a view has meant that the significance of visual factors in the reading process has been somewhat overlooked. Despite this, a number of studies have looked into the effects of ‘visual stress’, experienced by some with dyslexia (as well as some without). In my role as Dyslexia / SpLD Coordinator I am aware that my students have particular strengths and weaknesses that are inextricably linked to their dyslexia diagnosis. Reading difficulties are a common factor and persistent difficulties with reading at the word level can also associate with reading fluency problems, slower reading and comprehension difficulties.

As a dyslexia tutor, assessor and visual stress screener my role encompasses identifying and diagnosing visual stress difficulties on a daily basis with ‘visual stress’ now recognised as a co-occurring difficulty in an assessment of dyslexia. However, whilst visual stress commonly co-occurs it is not considered to be a ‘characteristic feature of dyslexia’, however there are other visual factors which could prove to be of equal significance to those of the phonological skills. If so, this could have important implications and provide necessary insight into my ongoing support of students with dyslexia.

There exists very little evidence that students actually respond in a positive way to phonics intervention i.e., in terms of improvements being made to reading ability (Davis, 2015). West (2007) also remarks that dyslexics are often so ‘visually dominant that ‘sounds’ just confuse them’ (p.19). However, what about changing the aesthetics of a page of text? In some respects, this

could be deemed to be easier to implement, therefore questioning to what extent this might impact on the reading ability of students with dyslexia?

The investigation of the research

With the above-mentioned points in mind, the following research seeks to examine the role that altering letter size and spacing in text may have on improving reading speed, as well as accuracy for students with dyslexia. This can be linked to Bouma's law of crowding (1970) which refers to the 'impaired recognition of a target due to the presence of neighbouring objects in the peripheral visual field' (cited in Martelli et al, 2009). In addition to Bouma's observation, my own experience also finds that dyslexics appear to be unusually affected by crowding, such as perceiving text to appear as jumbled when reading. To do this, I will explore through the literature the visual aspects that are thought to be involved when the process of reading takes place. This will consider both current and past research which has examined the role of the visual processes and the view of key researchers in the field such as Stein, Valdois, Gori and Facoetti, and Bosse, some of those who have sought to bring the importance of these aspects to further light. Following on from this, I will examine the relationship between font and spacing within a text-based document and the effect that this may or may not have on affecting reading speed and fluency. Reading fluency and accuracy are generally considered to be intertwined; reading inaccuracies can slow the reader down, resulting in a lack of fluency. Less fluency when reading is thought to affect a reader's positive engagement with the text and their ability to make efficient sense of what they read. Weaknesses in these skills areas are often common in those with dyslexia (Jones and Kindersley, 2013). It could be suggested that if reading fluency might be improved then this may support the easier formation of mental pictures when reading and as a result, subsequent improvements in comprehension.

Research Aims

A major aim of the research is to establish the possibility of an association between that of letter and word spacing / font, with that of reading speed and errors made. Sampling from students will provide evidence of this and allow for further analysis of the nature of errors made when reading to establish which of those are due to phonological weaknesses and which are of a more visual nature. It is hoped that by being able to identify the types of errors that dyslexic students make when reading, this knowledge will help to inform the focus of any support intervention going forward. There are also other practical implications for understanding how a page of text may be perceived by a student with dyslexia, i.e. regarding positive adaptations that can be made to printing style and layout.

Aims

This study aims to explore the effect that altering letter size and spacing in text may have on affecting reading speed and accuracy for students with dyslexia. This broader aim can be divided into the following areas, which have been framed by the literature, my own practice and ongoing professional development needs:

- To establish the historical emphasis of the literature in comparing the relationship between language-processing and visual-processing in dyslexia
- To identify the causal and influencing factors thought to be responsible for reading difficulties associated with dyslexia, particularly considering the role of visual aspects in reading development
- To investigate how altering the aesthetics of a page of text may affect the reading performance (reading speed and accuracy) of individuals with dyslexia

These aims inform the research throughout this study.

Summary

The introduction presents a background and context to the study. This is essential for understanding why this study is of importance in relation to my own students, as well as in my professional role and progression as a specialist teacher / assessor. The Literature Review follows on in the succeeding chapter. This deals with answering the first of my three aims. It does so by considering in depth, the research that currently exists in relation to language-processing and visual-processing that associates with dyslexia. It will seek to address which are the key issues to emanate from the research, where the main emphasis lies and if there are any gaps in the research, also considering why this may be the case.

Chapter Two: Literature Review

Introduction

This chapter will examine the historical evidence, together with current thinking relating to reading difficulties and dyslexia. This is essential in establishing the focus of the literature and in taking note of how the research may be evolving, how previously explored themes have been revisited and where strong evidence now exists to create a shift in the thinking. The following chapter will look into causes and effects of dyslexia and in particular, how visual factors are thought to influence reading ability. These visual factors are analysed independently in separate sub-sections, and also looked at as part of a wider context in the understanding of reading difficulties that are thought to associate with a profile of dyslexia.

A dyslexic model

With regards to the nature of dyslexia, the literature is often wide-ranging and as a result, definitions tend to vary. In spite of this, there is a general consensus amongst researchers, specialist teachers and assessors that considers dyslexia as being that of a language-based difficulty and as such, providing an inextricable link which associates dyslexia with reading difficulties. The definition of dyslexia that is provided by the Rose Report (2009) remains to be the most commonly accepted version and describes dyslexia as a learning difficulty that principally affects the skills that are required for ‘accurate and fluent word reading’ (p. 9). Traditionally, research that focuses on deficits in phonological abilities has appeared to dominate the literature, with the Rose Report referring to these deficits as being ‘characteristic’ of a dyslexic profile.

Whilst the study of the sound structure of language; phonology, has remained historically to be the domain of linguistics and speech scientists, more recently however this has evolved to include other interested parties from the fields of education and psychology who want to further understand certain aspects of processing that take place when learning to read and write. Phonological processing is the term used to describe some of those processes that relate to reading and which are now accepted to be a key factor in the diagnosis of the ‘language-based disorder’; dyslexia (Wagner et al, 2013, p. 7).

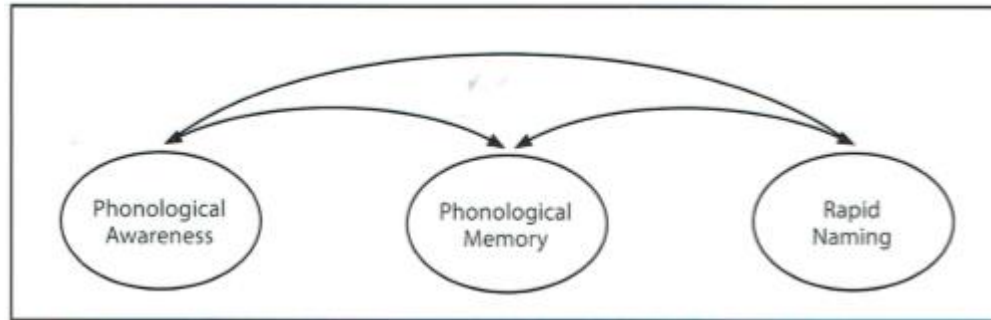


Fig 1. The model of phonological processing (Wagner et al., 2013, p.5)

Some aspects of phonological processing such as phonological awareness are thought to relate to the development of reading ability, in addition to those such as phonological memory and rapid naming ability which can be related to the development of written language. Phonological awareness is best described as the ‘ability to identify, segment, blend and manipulate sounds of spoken language’, also known as phonemes (Jones and Kindersley, 2013, p. 4). This evidence has tended to create a widespread agreement amongst experts in the field of dyslexia for phonological weaknesses to be traditionally considered central to a dyslexic model (Snowling, 2000 cited in O’ Brien, 2005). In other words, dyslexia remains widely thought of as a consequence of a phonological deficit (Lobier et al, 2011). Nonetheless, it should also be acknowledged that whilst there is strong evidence in support of early phonological intervention in children, this strength of evidence simply does not exist in the case of intervention with adult learners (Ball and Blachman, 1991; Cunningham, 1990, cited in Wagner et al., 2013).

The role of visual skills in reading

Despite the view discussed above, a body of research continues to emerge that evidences a distinct shift in the thinking. This has deemed to further explore the effects that visual and auditory processing can have on reading ability, and in doing so, questioning a long-held assumption of there being one primary cause (phonological processing deficits) for dyslexic reading difficulties (Meng et al., 2011). This is not to say that visual causal models were not acknowledged in the early literature, however admittedly these were not explored within any great depth. Morgan (1896) referred to reading difficulties by using the term ‘congenital word blindness’ while Orton (1928) identified the existence of ‘strephosymbolia (twisted symbols)’ (cited in O’ Brien, 2005, p. 1).

Also, of historical relevance is Frith’s (1985) early 3-stage Model of Skills for Reading and Writing Acquisition. Stage two, the Alphabetic stage of Frith’s model highlighted the role of the phonological skills in the normal development of reading and writing. However, more importantly Stage one, the Logographic stage was concerned with acknowledging the role of visual skills within reading development, as well as in recognising visual cues. Stage three, the Orthographic

stage required a learner to be combining both their visual and phonic skills in order to achieve normal reading development (Frith, 1985; Jones and Kindersley, 2013). With this in mind, it would appear that the research has come full circle. Gori and Facoetti (2015) reiterate this point of view suggesting that to assume the existence of a single causal relationship between reading ability and phonological awareness to be surrounded by controversy, as;

no published study has been able to clearly call for a causality effect between phonological awareness and a reading disorder (2015, p. 2).

This certainly throws into question any justification for there being such a primary focus on the phonological factors, to the exclusion and non-acknowledgement of the visual aspects. This opinion is shared by others in the research field such as Stein (2001) and also Fowler (2016) who strongly believe that reading disorders rarely stem from phonological disorders. Instead they are turning to the existence of alternative deficits in cognitive processing such as the visual attention (VA) span theory, for an answer (Bosse et al, 2007).

Furthermore, if auditory skills in a dyslexic learner are weak and, in particular their audio memory, then this can be seen to affect their acquisition of phonics. This therefore prompts those with dyslexia to consider alternative strategies to phonics intervention in helping to improve their reading ability (West, 2008, p.19; O' Brien, 2005). Steadily growing evidence appears to suggest that dyslexia is 'not exclusively a language disorder' and also importantly that receiving training in phonological awareness does not automatically relate to noticeable improvements in reading ability (Agnew et al., 2004; Galuschka et al., 2014; Strong et al., 2011; Dispaladro et al., 2013 cited in Gori and Facoetti, 2015). Whilst certainly not seeking to dismiss the importance of the phonological factors in the process of reading, current research (Meng et al., 2011), also strives to explore in more detail the additional role of visual processing aspects, thought to be specifically concerned with the 'accuracy and speed of working with detailed visual information such as letters' Jones and Kindersley, 2013, p.8). To achieve a certain level of reading fluency requires an interaction of specific skills to take place. According to Rasinski, these skills are particularly concerned with accuracy, speed of reading and expression, which, when working together efficiently they enable reading comprehension to occur (Rasinski, 2006 cited in Cotter, 2012).

Visual causes and effects on reading performance

Suggested causes and effects characteristic to dyslexia are discussed in detail below. These would appear to provide evidence of there being a relationship between visual processing difficulties and reading ability, one main theory being that of the Magnocellular Deficit Theory.

1. Magnocellular theory

One theory that would appear to dominate the literature, although at times somewhat controversially, is the magnocellular theory of dyslexia. This theory concedes the importance of there being a distinct relationship that exists between the eye and the brain during the process of reading (Singleton and Henderson, 2006). Whilst current research has been able to establish a link between children who present with significant reading problems and the ‘visual fixation of words’, this is by no means an established theory. What it does do however, is seek to provide some sort of platform for alternative theories, as represented by the magnocellular deficit model, which is in opposition to the historically-favoured phonological deficit model, discussed earlier (2006, p.89). There is certainly a case for supporting research into these alternative theories as Singleton and Henderson suggest that by incorporating visual factors into ‘theories that currently focus almost exclusively on phonological factors’ this might help to improve future scientific understanding (2006, p. 89). This view is also shared and promoted by other researchers in the field such as Stein (2001) and Fowler (2016).

There is a widely held opinion amongst the research that deficits that can be found in the visual magnocellular system might have an effect on reading performance (Skottun, 2003; Stein, 2001; Meng et al., 2011). Stein’s view (2001) argues that in the case of dyslexia, the visual magnocellular system is deficient and less well developed, therefore affecting stable eye fixation and motion sensitivity. He describes the eyes as being ‘never completely stationary’ as a result of the magna nerve cells in the brain having responsibility for overall control of eye movements (2001, p. 20). The existence of a deficit in the magnocellular pathway has been proven to affect visual perception when reading and cause a difficulty with the sequencing of letters, which, as a result, can sometimes be seen to move or blur on the page (Stein, 2001; West, 2009). This difficulty with visual motion sensitivity is thought to be responsible for the typical problems experienced by dyslexics when reading (Stein, 2001; Stein and Walsh, 1997; Meng et al, 2011, p. 161).

The process of reading is dependent on the reader having sound orthographic skills in addition to having secure phonological skills (Frith, 1985). It can be assumed therefore, that if the visual magnocellular system is thought to be ‘responsible for timing visual events when reading’ (Stein, 2001, p.12), its role could be significant in detecting visual motion when reading. This is a necessary process for the development of good orthographic skill. It should be acknowledged however, that whilst it is generally accepted that the magnocellular system has some involvement in the reading process, there also presents evidence to dispute how significant a role this actually is. Skottun (2003) likens the visual system in its entirety as being that of a ‘bottleneck in the visual pathway’ (p. 134) and argues that whilst there is clear potential for the magnocellular neurons to

be a cause of reading problems, these neurons actually only make up 10% of the visual system as a whole. He states therefore, that the identification of a deficit in any of the main areas could arguably be expected to have some sort of impact on a person's reading ability (Ahmed and Spear, 1993; Peters, et al., 1994 cited in Skottun, 2003, p. 134). In addition, Skottun acknowledges that the existing evidence does not actually suggest 'dyslexia to be caused by a magnocellular deficit' (2003, p.134), but rather to be an effect of it.

In contrast to the previously discussed view, an interesting study into the reading development of Chinese school children (Meng et al., 2011) explored to what extent their reading may appear to be dependent on their visual perception. As the structure of the Chinese language seems to rely on having good visual-orthographic processing ability (Zhou and Marlen-Wilson, 1999, 2000 cited in Meng et al., 2011), it can therefore be assumed that any study examining deficits of the magnocellular pathway could be seen more evidently through use of Chinese participants. Previous studies into the reading development of Chinese also established there to be deficits in orthographic processing, but more significantly these were 'found in a large subset of dyslexic children' (Ho et al., 2004; Meng et al., 2007; Song et al., 1995 cited in Meng et al., 2011, p. 163). Meng et al's study further built on the results of this previous research and as such found there to be a strong link between perceptual tasks required for reading and the role of the magnocellular pathway in this activity. Significantly, the results have suggested the magnocellular pathway to be 'substantially implicated in Chinese reading' (Meng et al, 2011, p. 168). This not only provides further evidence in support of the magnocellular deficit theory but also reinforces the importance of Frith's early model (1985) which recognised the essential role of visual skills in the development of reading ability.

It is clear that the majority of literature is able to support the view that dyslexic individuals have reduced sensitivity in either the visual or auditory pathways. Evidence provided by Stuart et al's own study (2006) offers some contradiction to the magnocellular theory as it suggests instead for there to be an impaired sensitivity within the auditory, rather than visual pathways. In terms of finding any evidence to support the magnocellular deficit theory his own study was unable to do so. As such, Stuart et al's study was seen to question the validity of the magnocellular deficit theory as being a significant causal factor of reading difficulties. Sensitivity in the auditory pathways can be linked to a difficulty with grapheme-phoneme correspondence and therefore this adds further strength to the phonological deficit theory.

When research has been carried out into the magnocellular deficit theory this uses contrast sensitivity as a measure of function, a method which was further promoted by Habib (2000) and his conclusion that 'the best demonstration of a low-level visual deficit in dyslexia is that of altered contrast sensitivity' (cited in Stuart et al, 2006, p. 1225). Stuart et al however, were unable

to support this theory through the findings of their own research which highlighted a ‘series of recent negative findings’ and therefore, might serve to question a ‘serious reconsideration’ of the magnocellular deficit theory (2006, p.1225).

2. Crowding theory

Notwithstanding that there are other visual factors that might affect reading efficiency; one visual deficit in particular that has been deliberated upon in the research is that of visual crowding. As the visual fields within the brain are separated into two fairly distinct regions; the central and the peripheral fields, each of these fields provides us with the ability to carry out different visual functions. The central field is primarily concerned with visual search ability as well as enabling the capacity to take note of visual detail. Research into this domain has spotted an emerging pattern which suggests that in the case of dyslexics most will tend towards stronger use of the peripheral field over that of the central field and evidences this to be the result of deficits in their visual search ability. Whilst this acknowledges there to be a weakness, there is also a positive association that can be seen with possessing strengths in the peripheral domain; necessary for a holistic visual-spatial perspective (Schneps et al, 2007). In fact, a number of students who study Art and Design also have dyslexic traits, are seen to be strong visual thinkers and naturally gravitate towards more creative careers which harness their visual-spatial strengths (West, 2007).

Tasks that rely more heavily on use of the central visual field, therefore requiring an individual to have good visual search ability can be seen to result in a weaker performance when navigating ‘busy’ pages of text, as well as those with a mathematical or science-based layout. When reading, whilst acknowledging that the words can sometimes be identified by the given context of the sentence, the crowding together of word parts and letters can also make the identification of individual words in a sentence particularly difficult, unless these are given appropriate spacing, often known as ‘critical spacing’ (Bouma, 1973, cited in Pelli et al., 2007).

When relating visual crowding to reading difficulties and dyslexia this is best explained as being a difficulty in recognising smaller objects, such as letters on a page. The activity can become especially difficult when these objects are surrounded by other letters. This particular occurrence is as a result of critical spacing, in other words, ‘the smallest distance between letters that avoids crowding’, and is anticipated by Bouma’s law of crowding, 1970 (Pelli et al., 2007, p. 1; Gori and Facoetti, 2015). Research into the relationship between reading difficulties and dyslexia has explored the direct link that crowding might have on reading performance. This research has predicted that problems with crowding could lead to slower reading speeds, in addition to increasing the likelihood of making errors when reading (Gori and Facoetti, 2014). As reading is not simply a technical exercise but one carried out to derive meaning from the text, it must be acknowledged therefore, that a slower reading speed is only one factor thought to affect

comprehension. The skills of accuracy and expression are also thought to be associated with an ability to gain understanding of the text, as when these are combined they facilitate fluency to occur (Rasinski, 2006 cited in Cotter, 2012).

3. Changes to text – print size, font and spacing

Past research has tended to focus mainly on the underlying skills needed for reading, namely those concerned with language, processing and higher order thinking metacognitive skills. Whilst research efforts have remained primarily concentrated on the above-mentioned areas there has been less resulting focus on the ‘perceptual properties of text,’ such as the consideration of the effect of print size, text spacing and line length (Katzir et al., 2013, p. 1). The importance of having clear and accessible text is already an established recommendation for those with visual impairments, but not yet widely utilised for those with dyslexia. Whilst the UK Association for Accessible Formats (UKAAF) suggests that dyslexic individuals may additionally find adapted materials and text to be a necessary modification, it also stresses that the provision of accessible information is a ‘key requirement of the Equality Act’ (2012, p. 5). This helps to acknowledge dyslexia as being that of a ‘print disability’ (p. 5) and supports the case for modifying print, not only to be seen as best practice, but essential in order to conform to inclusion policies. In contrast to the above view, Diemand-Yauman et al’s 2010 study found that by presenting text in hard-to-read fonts this enabled a deeper cognitive engagement to take place when reading, thus resulting in improved memory and retention of the information. This serves to cast some doubt on whether easier to read information actually hinders a deeper processing to take place, which may, in fact, be both beneficial and essential for learning, particularly long-term. The 2010 study believes that it is all too easy to assume that when information is easier to encode this will often be deemed as a learning success, however the deeper processing that disfluency interventions enable, such as hard-to-read fonts, require a more active, rather than passive engagement with the text. This is seen to result in better memorisation and learning outcomes (Diemand-Yauman et al., 2010). With this in mind, whilst a simple change of font may be seen to improve learning potential for general undergraduate students, this research does not deem to address however, those who already have diagnosed cognitive difficulties, such as associate with dyslexia. In these cases, a hard-to read font may result in more effortful processing and missed information as a consequence. It should be acknowledged that Diemand-Yauman et al’s research does not cover those with particular processing problems, such as dyslexia, therefore it remains unclear as to how such font interventions can be of benefit, or hindrance, to students such as these.

A disinterest in reading can often be assumed, in part, to result from a lack of motivation. However, how someone views a page of text could be presumed to affect how they read. This thought was explored through Piers Cornillisen’s research into visual confusion (1991) by asking

children how they perceived words on a page to look and whether the words appeared to move, blur or glare (Cornellisen et al, 1991). Although there has been some research conducted into how altering the presentation of text can affect reading performance, research still remains somewhat limited, in addition to discovering some disparity to exist across the findings. Some of this is explored in the following paragraphs which look at the changes made by altering the text formatting, such as through changing the print size, font and spacing. With this in mind, it is useful to consider here the spacing that delineates one word from another word, or a letter from another letter which has, according to Reynolds and Walker (2004), always been a significant feature in assisting in the identification of letters and words of Latin origin (such as English). The reason for such a focus on spacing is to be able to maintain a sense of visual cohesion and therefore making text easier to read. The existence of fixed word spacing in children's books did not become commonplace until far into the twentieth century; prior to this, text was often justified, therefore resulting in more variable word spacing. As a result, children's books often gave the impression of being particularly difficult to read (Reynolds and Walker, 2004).

A number of studies have suggested there to be a relative link between the size of the print and the reading performance of dyslexic participants; more specifically that increasing the print size has been seen to result in improvements in reading speed and accuracy (Stein, 2003; West, 2009; Cornelissen et al., 1991 and Skottun, 2001, cited in O' Brien, 2005). What is significant is that the emergence of such positive results provides yet further evidence of the existence of a strong visual element that can be associated with reading skill. This suggests the clear existence of a relationship between vision and dyslexia. It is unlikely that such an association would have been recognised through those studies that focused solely on phonological processing ability (Skottun, 2001; O'Brien et al., 2000 cited in O'Brien et al., 2005). As such, it remains likely as a result that the importance of the role played by the visual factors may easily have been missed. O'Brien et al's research (2005) found 'critical print size to decrease with age' (p. 9) and therefore this research serves to strengthen the case for younger children to be accommodated with larger print when reading, in order to maximize their overall reading performance (Hughes and Wilkins, 2002, cited in O'Brien, 2005). More importantly, O' Brien et al's study also found that a group of participants with dyslexia additionally benefitted when they were given reading material with an increased print size. As a result, this was explained as being the result of a 'general developmental lag' (O' Brien et al, 2005, p.1). In addition to this, a study by Wilkins et al (2009) with children aged 7-9 years found their reading attainment to be affected by font size, most importantly that these children were seen to read better when presented with text of a larger font size. In contrast to these results however, Katzir et al's study (2013) found that when the size of the print was decreased this then resulted in higher comprehension scores. What is clear is that at present there

exists a lack of sufficient quantity of evidence to support these differing findings and add weight to either argument.

In 2008, Boer, a Dutch graphic artist designed a font which was aimed at enabling easier reading for those with dyslexia. Boer's aptly named 'Dyslexie' font was characterized by the letters being presented as being both bolder and larger, with some sitting higher and with wider letter openings, assuming that this would allow the reader to distinguish between the letters more easily. A study of the Dyslexie font was carried out in 2016 in order to evaluate its effectiveness for its dyslexic readers. This was as a direct result of there being very little evidence available to promote its value, despite having received widespread media coverage (Marinus et al., 2016). The 2016 study observed reading performance across a variety of texts and compared the Dyslexie font with that of the sans serif font Arial, often frequently favoured by dyslexic readers. Both letter sizing and spacing settings were examined closely in the study. Results found that while reading performance for the dyslexic participants using the Dyslexie font increased, this was not actually as a direct result of its 'specially designed letter shapes' as had been previously assumed, but more importantly, due to the font's 'particular spacing settings' (Marinus, 2016, p. 1). Dr. Sue Fowler (2016) also believes that the gaps that a larger print size create around the words can result in easier processing. As a larger print size tends to be easier for younger readers to process, this means that any print movement experienced by those with dyslexia could potentially be lessened, with the resulting larger gaps between the words thought to reduce interference with the next word (Patoss website, 2016). Again, this highlights a lack of research to exist that has the ability to focus solely on individual aspects of text presentation such as; font size, type of font or spacing, with the danger that in many cases results are more likely due to observation of these factors as a collective group. This creates the possibility of such findings not only being somewhat limiting, but in some cases invalid. Also of consideration is that whilst reading difficulties may be due to one of a number of visual factors that have been outlined in this chapter, it seems more probable that such difficulties may, to an extent, be as a result of all of these. As it is likely that these factors are inextricably linked this makes it extremely difficult to be able to tease these apart for closer analysis and to then establish the correct intervention to follow.

Establishing how a dyslexic's eyes might move during the process of reading could prove essential in understanding how the view of a page may affect processing accuracy. West (2007) believes that dyslexics demonstrate different eye movements when reading. As such, they tend to process this reading information in a more holistic, visual-spatial manner, as opposed to how a non-dyslexic might move their eyes from letter to letter and from word to word. With this in mind, he is inclined to 'limit the number of words to five per line' when working on reading skills with children, to facilitate easier processing (p.20). West has discovered through his own experiences through being dyslexic himself, as well as through working closely with others in a teaching

capacity, that when text is presented in columns, this can in many cases serve in making it easier to read. Therefore, he chose to alter the text in his book 'Footnotes' to present with a larger font size and increased line spacing, which he believes leads to improved accessibility for his readers (West, 2007).

4. Visual attention span deficit

West (2007) and Stein (2001) are not the first experts to investigate vision and eye movements in those with dyslexia. In fact, a vast body of research has already established there to be a strong link between abnormal eye movements found in those with dyslexia, and the existence of what is known as a visual attention span deficit. This deficit is in 'the number of individual visual elements that can be processed simultaneously' (Lobier et al, 2011, p.2). What remains less clear however, is whether such abnormal eye movements are merely a consequence of dyslexic reading difficulties, or more specifically, a primary contributory factor in themselves (Pavlidis, 1981 cited in Prado et al., 2007).

With this in mind, Huckauf and Heller (2002) suggest that rather than viewing theories such as crowding, visual-attention span, letter and word positioning as being separate entities which seemingly impede or improve reading speed and accuracy, instead these should be considered as factors which instinctively interrelate with one another (Huckauf and Heller, 2002, cited in O'Brien, 2005). This has obvious implications for the direction of future research and also poses questions as to whether it is actually possible to focus solely on individual theories such as those mentioned above, without also seeking to acknowledge the complimentary contribution of other theories alongside. In fact, the co-existence of factors, or difficulties which are seen to overlap within a profile of dyslexia is commonplace and recognised through the concept of neurodiversity (Hulme and Snowling, 2009, cited in Jones and Kindersley, 2013). As it becomes likely that additional factors might also have an important bearing on results, if these are not properly acknowledged then any results from research could be seen to be misleading and risk validity.

5. Visual processing difficulty – visual stress

If exploring the impact of visual factors on reading for those with dyslexia, it is important to take into account the visual processing difficulty; visual stress. It is usual for those with visual stress difficulties to perceive a page of text differently and therefore affecting their ability to read with a degree of fluency, accuracy and comfort. As visual stress is a processing difficulty rather than a vision problem or sight abnormality, this means that in many cases it can be treated by successfully placing a plastic coloured overlay over text when reading, or by wearing tinted lenses, which can be seen to alleviate symptoms. Importantly though, whilst visual stress can often co-occur with dyslexia (and other specific learning difficulties), it is certainly not the case that all dyslexics will experience visual stress.

Summary

To summarise the points discussed above, it would appear that there now exists a range of literature which recognises the significance of visual factors upon reading ability. Whilst this literature seeks to challenge a traditionally considered view of phonological processing being central to a model of dyslexia, this view has yet to become widespread amongst many experts in the field. As such, the importance of the phonological processing role in reading still continues to dominate. This leaves the contribution made by the visual (and auditory) pathways, yet to be fully appreciated. This would appear, in part, to be due to the fact that much of the earlier research has tended to emanate from professionals whose backgrounds in education, speech and language and psychology has resulted in their research being mainly focused on the relationship between phonological processing and early reading. What this research focus does is emphasise the phonological processing aspects and to a degree, acknowledge associated auditory processing (in particular, examining the sound structure of language), however, in doing so, this fails to recognise the importance of the visual role.

Another problem that is highlighted is that of being able to pin down which visual aspect(s) are at the cause of a dyslexic reading difficulty, possibly as a result of the visual system as a whole being so complex. It is important to acknowledge that it may be one of a number of factors (as detailed in the preceding paragraphs), or alternatively may be due to elements of any number of these. Co-existing factors are common within a dyslexic profile and this makes it difficult within a research study to consider, and to unpick all of the possible influencing factors, in order to establish a clear causal picture.

Research which explores changes to text presentation remains as yet, somewhat limited. It should be acknowledged that as any effects noted to date have tended to be minimal or controversial, a greater volume of research is therefore still required in order to build a more comprehensive and ultimately valid picture of the implications that such changes may make to reading ability. To add, any alterations made to text have, in the past, been considered to be costly and not always easy to reproduce professionally in print, providing an additional reason why such changes may not have been positively embraced by researchers. Also to consider, is that unless a body of research is able to agree on what changes should be made (these as yet remain to be unclear), such changes are unlikely to be implemented.

Another important point to consider, is that highlighted by research which has explored the positive effects that can be gained through making fonts hard-to-read. The deeper cognitive processing that is thought to occur when reading hard-to-read fonts has been associated with improvements in memory and comprehension. Whilst this is of interest, such research has not been concerned with the effect that hard-to-read fonts might have on those students who have

established processing difficulties, such as with dyslexia. Therefore, it is as yet unclear as to whether such fonts may actually serve to hinder learning for a student with dyslexia even further.

Finally, there are a number of theories that exist (above) that have been able to provide sufficient evidence into how visual aspects can affect reading ability for those with dyslexia, and importantly these are independent of a dyslexic model.

Chapter Three: Methodology

Introduction

The Methodology chapter follows on from the preceding review of the literature and incorporates the aims of the research, the particular methods that were adopted for the research, the research schedule, a look at the sampling group, ethical considerations, how the research was conducted, methods then chosen for analysing the research, and also how the data was chosen to be presented.

Research aims

The study explored how altering the letter size and spacing in text might have an effect on reading speed and accuracy for my students with dyslexia. This main aim was then subdivided into the following areas:

- To establish the historical emphasis of the literature in comparing the relationship between language-processing and visual-processing in dyslexia
- To identify the causal and influencing factors thought to be responsible for reading difficulties associated with dyslexia, particularly considering the role of visual aspects in reading development
- To investigate how altering the aesthetics of a page of text may affect the reading performance (reading speed and accuracy) of individuals with dyslexia

The aim of the study was to establish whether by changing the independent variable (font, spacing), what effect this might have on reading speed and accuracy (the dependents).

To access and gather the data to meet my first research aim, I looked to a number of research studies, as well as literature relating to dyslexia and reading difficulties. This collated information, together with identification of the key figures, past and present, who have been involved in dyslexia research, allowed me a greater perspective. These key figures were drawn from a range of disciplines within the fields of science, psychology, optometry, speech and language, and education.

This research also helped to inform my second research aim, in terms of helping to isolate the factors believed to cause, or affect the reading difficulties of dyslexic individuals. Those factors which were of a visual nature were of particular interest to this study due to how these might be seen to link to reported reading difficulties of my own students.

To investigate my third research aim, I utilised quantitative methods to assist in collecting my data; in calculating the reading speed of my participants and following this by analysing the data through use of miscue analysis, thus allowing me to identify patterns of errors.

Rationale

This chapter sought to address issues that I highlighted in the previous chapter and to provide some justification for my chosen research methods by doing so. There is some acknowledgement from current research of the existence of an association between the way text is formatted and what effect this might have on the reading performance of students with dyslexia. More specifically, in terms of a dyslexic student's ability to be able to access reading information effectively. Nonetheless, this research continues to remain somewhat limited. To date, much of the research has tended to focus its effort on one particular area; analysing either the reading speed, or reading comprehension, meaning that any additional analysis which relates to the pattern of errors made when reading has tended to be overlooked. Strong evidence exists that could be seen to link the kinds of difficulties that are encountered at the word level with having a subsequent effect on reading fluency and comprehension (Jones and Kindersley, 2013). As a result of this, I felt that it was important to look to analysing both the reading speed and also the miscues that occurred, within this research study.

Research methods

My research methods were selected as to be deemed the most appropriate to my study and with an aim to helping to answer those questions suggested by the research. My thinking was to be able to generate sufficient data to allow an opportunity to take note of any patterns and correlations, therefore my research methods were chosen accordingly. Participants' reading speeds were calculated and then represented in terms of providing a standard score and also in words per minute, therefore providing data of a quantitative nature. Participants' errors were viewed in a slightly different way. While patterns of errors provided a body of numerical and therefore quantitative data, standard scores were not calculated in this instance. Instead, miscue analysis was used to provide further detail to ensure that resulting support recommendations would be individualised and specific to a participant's needs. Beyond calculating scores, being able to then go on to evaluate the test data remains to be an essential part of an assessment of students with dyslexia. This helps to identify important underlying factors which may be affecting performance and will provide key information that goes towards any support intervention, or the recommendations that follow. In radically looking at the data and interpreting and analysing this appropriately was an essential part of this study, not only in terms of ethical considerations but also bearing in mind how the scores, or results, were arrived at by the student (Clough and Nutbrown, 2012). It was also necessary that I was able to control the situation by being able to alter the variables, in this case the variables being the layout of a page of text. As quantitative studies tend to 'emphasise the measurement and analysis of causal relationships between

variables', this confirmed further my reasoning for adopting this particular method of research design (Denzin and Lincoln, 2005, cited in Clough and Nutbrown, 2012, p.21).

It can sometimes be the case with quantitative data and the subsequent generation of numbers that this creates, that it is not always able to provide enough information to tell the whole story. As a result, quantitative data can sometimes be viewed as somewhat limiting and therefore deemed to lack sufficient validity. With this in mind, I was aware of the importance of also establishing a background context to the sample group. This came from second-hand reference to documents such as a diagnostic report, or screening results, as well as considering each participant's previous educational experiences. On a positive note, it was felt that quantitative data would lend itself well to presenting my findings clearly, in a format such as a table or graph.

Having explored literature and research with a similar focus to my own, I felt confident of a general pattern of a quantitative approach emerging. More specifically, parallels could be drawn with my own research, in terms of systematic use of standardised tests. For example, Lobier et al (2011) used tests such as Raven's Progressive Matrices and The Alouette Reading Test which generated statistical data as the result of the absolute nature of this kind of test. In addition, the use of experimental design and the altering of the variables associated with this meant that common correlations could more readily be observed and a participant's errors confirmed through audio-recording the reading performance. An example of where reading performance was initially recorded, so as to be able to analyse this later was O'Brien et al's 2005 study which used this recorded data to allow comparison of reading rates with altered print size.

Research schedule

It was essential in the organisation of my research schedule that I considered any timetabling restrictions of my students, those of my own role and of my organisation. This invariably meant that my data collection would need to be carried out during term time only, also factoring in for there to be a one-month time period between administering part 1 and part 2 of the research. As such, the reading research was planned to fit either side of the Christmas holiday. This gave me the preceding summer term to collect and read relevant literature and research articles that I deemed to be important to my study. My participants were chosen across the first academic half-term and part one of the research was embarked on across the second half of the term which took me up to the Christmas break. Part 2 of the research was then carried out in the spring term following the Christmas break. It was felt that by positioning the research period at this time this would eliminate any attendance problems thought to arise as a result of exams taking place around the Easter period or across the summer term, in addition to absences that often occur as a result of student work placements.

This would then allow me plenty of time to present and evaluate my data and to start to write up my findings.

Sample

The participant group was chosen from 10 of my own students who are currently studying in my organisation. All have a diagnosis of dyslexia. My resulting student sample was made up of 4 male participants and 6 female participants. Their ages ranged from 17 years up to 30 years and encompassed a mix of abilities and educational backgrounds. This was to ensure that the sample group was not arrived at randomly but was directed towards being representative of a much wider student population (Thomas, 2013). Although I would only be observing a fairly small subset for this study in comparison to other similar studies which have involved much greater numbers (Schneps et al., 2013 had a participant group of 27), the group was chosen with the wider population in mind and therefore aimed at providing an accurate sampling of this. It was felt that this would still allow a large enough sample size to be able to aggregate performance. It should be acknowledged that there were practical limitations to use of greater numbers due to timetabling restrictions and access to a limited cohort (students with diagnosed dyslexia) within the organisation.

Sampling methods were drawn from both opportunity sampling and stratified sampling. Initial opportunity sampling meant that my choice of participants came from students with a diagnosis of dyslexia and who were already accessing Specialist Support with myself in the organisation. Therefore, this enabled easier access to a prospective sample group and a more rapid process of recruitment. Whilst this method of sampling might be seen to have some disadvantages and possibly viewed as biased (the group was limited to students within further education), a stratified sampling method then followed with which to draw from within this initial group. This meant that I was able to then narrow the sampling to ensure its diversity in terms of age, gender and educational background (students working at different levels). That the decided sample group was representative of the larger population was important as this meant that my findings could then be applied to students with similar circumstances within the organisation.

The participants' past reading experiences included seeing dense text as 'crowded' and therefore difficult to navigate, with a propensity to lose their place when reading as well as to misread words. Of the participant group, 7 participants had co-occurring visual processing difficulties, also known as visual stress. The Professional Association of Teachers of Students with Specific Learning Difficulties (Patoss) recommend that consideration is given to students with visual stress difficulties in assessments and therefore 6 of the participants were also permitted use of a coloured overlay to place over the text when reading. The remaining participant wore Irlen Spectral lenses

(glasses with coloured lenses) which help to reduce visual stress difficulties, without requiring additional use of an overlay.

While the act of reading can present an ongoing challenge for my students with dyslexia, there is an expectation that at this level of their education they will be required to utilise effective skills for skimming and scanning text, comprehension, and to encompass reading at an academic level. The efficient working of these skills is integral for studying at this level but these skills are also needed for their successful progression on to Higher Education. Often students' reading can be described as hesitant or 'choppy' due to inaccuracies that occur when reading. This makes it difficult for fluency to happen and therefore this can be seen to create a barrier in being able to read for meaning.

Procedure

The reading skills of the participants were assessed using the Wechsler Individual Achievement Test -WIAT-11-T (Wechsler, 2006) (Appendix 3). The WIAT-11 Test is widely used for assessment purposes within my setting and it is common practice to be able to assess a student's oral reading accuracy, fluency and word recognition skills in context. This standardised test for UK teachers offers subtests in the key areas of reading; word accuracy, comprehension and reading speed and covers an age range of 4 to 85 years. The WIAT-11 Test is listed amongst 'Suitable Tests for the Assessment of Specific Learning Difficulties (SpLD)' (SpLD Test Evaluation Committee (revised DfES Guidelines) 2016). While being able to hear a student read aloud is considered of importance in assessing their current reading development, Ron Davies also argues that this can often be a preferred method of reading for those with dyslexia. It is often the case that having dyslexia means experiencing little or no internal dialogue when reading. This may mean not being able to hear internally what they are reading unless they are able to read aloud. This is an essential skill for the recognition of words, being able to correct errors and general fluency (Davis, 2010).

The primary research for this study was administered in two parts; part one and part two, leaving a time window of one month in-between each part administered:

Part one of the research:

- Administered the five age-appropriate reading passages from the WIAT-11 Test in line with test guidelines
- Reading aloud ability recorded using Dictaphone
- Timer used to record reading speed for each passage

Reading passages found in Appendix 2, Part one

Part two of the research:

- Administered the *modified* five passages in line with WIAT-11 Test guidelines
- Verdana font
- Font size – 14 point
- Double-spacing between words
- Text justified
- Title in Bold
- Reading aloud ability recorded using Dictaphone
- Timer used to record reading speed for each passage

Reading passages found in Appendix 2, Part two

Participants were administered the five passages selected as being appropriate for their particular age range and asked to read these aloud for part 1 of the research. The administration of the five passages was not only in line with the test instructions but also enabled the participants' reading to be observed across a range of different types of text. The texts also varied in length, ranging from the shortest passage 'Life Stages', containing 162 words, up to the longest passage 'Should City Zoo Raise Prices?', containing 343 words. According to the Department for Education and Skills' (DfES), Guide on Miscue Analysis (2018), offering a variety of texts can help to motivate the reader. Also, the DfES indicates that providing a range of texts can help to establish what miscues are being made and whether there is any particular pattern to these, such as; do miscues improve as the student progresses through the passage, due to becoming more familiar with the style in which it is written?

It is usual practice for a student to read aloud in an assessment situation and is a developmental norm. The reading speed of the participants was recorded for each passage and this was logged on the test form (Appendix 3). The Department for Education and Skills (DfES) recommend the use of recording the reading when evaluating performance, otherwise some miscues can easily be missed. The recorded reading allowed me to be able to listen, reflect on, and score the miscues later, being able to play the recording over again where necessary. Also, justification for use of a Dictaphone was that the participant could find it to be distracting were I to be writing down notes while they read. As students with dyslexia are often easily distracted this could have risked affecting their performance.

A participant's reading rate was then calculated in accordance with the test guidelines to provide each participant with a standard score for reading speed. A standard score 'turns a raw score (the original score unaltered) into one which enables meaningful comparisons across different age levels' and is a usual tool of dyslexia assessment (Patoss, 2018). The calculation of a standard

score will provide information on whether a participant reads at a speed that is in the below average range (or not) for his, or her age. A standard score of 84 and below is considered to be below average according to The Joint Council for Qualifications (JCQ) regulations (2017-18). Words per minute (WPM) were also recorded. To adhere to good practice, I also spent time in double-checking my score calculations. This is as any errors in marking may give a bizarre result and risk the validity of my data and as a consequence, negatively influence my interpretation.

To capture reading miscues a Dictaphone was used to record the reading of each passage and this facilitated a later analysis of reading accuracy through identifying particular error types. This not only helped in establishing the existence of reading errors but more importantly in identifying the pattern of errors being made. Any difficulties that may be due to other factors, such as those that stem from underlying phonological weaknesses (also typically associated with dyslexia) could then be viewed separately from those that may be associated with visual recognition. The scoring system used to record individual patterns of errors was adapted from a chart included in Klein's book (1997), this having previously been adapted from Walsh, 1979 (Appendix 5). This system is often widely used as a best-practice guide for miscue analysis by teachers and assessors alike. In addition to the use of Klein's scoring system, substitution miscues were further reflected upon to establish whether substituted words were of a visual or phonic nature, therefore providing some indication as to those errors that may be associated with the visual system, ie. Visual recognition. This was achieved by sorting substituted words into the following categories; MSV (Meaning, Structure, Visual) (see fig 2 below). Categorising in this way meant that the miscues could be analysed according to their source and assist in helping to separate out those of a purely visual nature (V). All other errors (including those which were of a phonological nature) were grouped together so that any resulting data would therefore consist of 'visual errors' and 'other errors' to enable comparison. The use of MSV miscue analysis helped to ensure that good, solid evidence could be collated to provide useful information as to the way a reader works with print. This allowed me to be able to make informed decisions as to the nature of a participant's patterns of errors, helping to pinpoint how they might be supported in terms of future reading instruction.

Miscues were analysed using the following categories; MSV :	
M	Meaning
Does the error make sense in relation to the meaning of the passage?	
S	Structure
Is the error influenced by the structure, or syntax of the sentence, up to and including, the error? Does it <i>sound</i> right?	
V	Visual (also known as graphophonic)
Does the error <i>look</i> similar to the existing word in the text?	

Fig. 2. Categories of miscue analysis

The passages were administered to the same participants again one month later (part 2). This time the format of the passages was altered and the text presented in a larger font size (14 point) as well as with the spacing increased (double spacing between words). To maintain consistency all passages were presented in a Verdana font, justified and presented on A4 paper. The titles of the passages were presented in bold font. In order to come to my decisions as to what specific changes I required to be made to the presentation of the passages, I referred to past research carried out into altering text, such as use of the Dyslexie font (Dawood, 2015; Marinus et al., 2016); the recommended standards set out by the UK Association of Accessible Formats (UKAAF) which endorses a minimum text size of 12 point for clear print, however preferably for this to be 14 point, in addition to there being adequate spacing and for A4 paper size to be used. I also referred to the British Dyslexia Association's website (BDA Technology, 2018) and more specifically their information on typefaces for dyslexia, which suggested a sans serif typeface, such as Verdana.

Possible threats to validity

In making specific changes to the text format this would allow me to analyse whether the altered aesthetics of the page had an effect on reading performance, specifically in terms of reading speed and accuracy. The decision was made to have a one-month window between the testing of part 1 and part 2. It could be argued that if the time frame was too short then the testing passages could be deemed to be still familiar to the participants and therefore this could be seen to affect the

validity of their performance, in terms of either improving their performance or demotivating them. On the other hand, there would be less chance in one month, than for instance in a year, for any external factors to have an effect, for example, the loss of a relative may deem to cause behavioural changes. They may have additional things on their mind and distract them from their performance at the time such as; assignment work to hand in, or personal problems that are worrying to them. These could be behaviours such as a lack of attention, motivation or an unwillingness to contribute that may influence the results of the performance. In summary, there were a number of extraneous variables to consider when carrying out the research with a possibility of these having an effect on the resulting data. Further examples not already addressed previously within this chapter may include the following: the time of day utilised to carry out the primary research might be best suited to some participants and not to others. This was difficult to control fully however due to the restrictions of timetabling. If too large a window was given between the administering of part one and of part two it could be assumed that improvements in reading during this time may have an effect on resulting performance in part two. In order to control this the time window was kept short – one month. My own body language is also an important consideration. It can be difficult to maintain impartial body language so as not to signal how they might be doing. Whilst this can be difficult to control due to not always being aware of what signals you might be giving off subconsciously, this is something I am practiced in being aware of in my professional role as an assessor.

In some cases, students will use compensatory strategies when carrying out a difficult task in an assessment situation, such as reading. An effective strategy can be seen to have implications for improving performance and the result of a higher recorded score. This test effort may compromise the validity of scores, and not give an accurate reflection of that student's attainment, also being seen to hide difficulties that can lie beneath the surface. Examples of strategies that may be used when reading might be: using a finger to keep their place; rely more heavily on use of context, or own sight-vocabulary to help predict words, rather than using decoding strategies, etc.

There are some instances where validity can be considered to be more difficult to control. Nonetheless, according to Cohen and Manion (2007), invalidity that can be associated with use of quantitative data can be minimised through the correct handling of the statistical information. Particularly in the case of this research study, validity might be improved through following correct administration and scoring procedures in line with the test guidelines.

Ethical issues

A number of ethical considerations were addressed prior to, and during the research study. These are presented below:

Firstly, to maintain confidentiality the participants' names were not used at any time, or indeed the name of the organisation in which the study took place. The participants names were instead replaced with the alias; student A, student B, etc. In replacing their real names with the above pseudonym this was to guarantee the ongoing protection of their anonymity.

Secondly, I gained the full and voluntary consent of the participants. Due to their dyslexia diagnoses, their ongoing difficulties with reading, as well as weaker processing ability it was necessary that I explained the project clearly and the purpose of the research, prior to commencing. Where necessary, language was modified and broken down. Only after they were able to give me verbal acknowledgement of their understanding did I ask them to sign a consent form (see Appendix 1: Ethics, for Participant Consent Form). This consent form stated that their identity would be protected throughout the course of the study and that all data collected would be treated as confidential.

In collecting my data, the participants were asked to read aloud, in this case using the standardised Wechsler Individual Achievement Test (WIAT-11-T). It is considered normal practice as an assessor and dyslexia tutor to utilise criteria such as a reading test, in order to allow an opportunity to assess development. Other examples of reading tests that are widely used by dyslexia assessors and educational professionals and where an individual may be asked to read aloud (to identify and analyse difficult areas) might be the Adult Reading Test (ART), or the Academic Achievement Battery (AAB). Nonetheless, the WIAT-11-T remains to be the most generally accepted test to meet the reading needs of students in further education.

My role as a dyslexia tutor, in addition to my role as researcher placed me in a natural position of authority and as such it was of ethical importance that this did not lead to the display of demand characteristics by the participants. This could mean that they may feel obligated to take part in, or to continue with their involvement in the research simply as a result of my having already established a trusting tutor-student relationship. Therefore, all participants were given the right to withdraw at any given time throughout the study.

My aim, throughout the course of this study has been for the research to evolve in line with my original research plan and my approved Ethics Form. As such, I feel confident that any ethical considerations have not required altering in any way. The Ethics Form can be found in Appendix 1.

Presentation of Data collected

Following the collection of data from the research, it was felt that a visual means of displaying this such as use of a bar graph or pie chart would allow the most appropriate method for analysis, enabling a chance to see any patterns or correlations more readily. Many similar studies (Lobier

et al., 2011; Pelli et al., 2014; O' Brien et al., 2005), due to the statistical nature of the data that results from use of standardised testing lend themselves to a visual presentation approach. This helps to convey detailed information concisely, making it easier to interpret.

Summary

This chapter justifies my chosen methods for this study; in producing quantitative data in line with most similar studies where current standardised tests have been utilised to generate the data (Reynolds and Walker, 2004; Zorzi et al., 2012). Whilst tests were carried out as per the test design, in part two of the primary research the text-based material was manipulated in terms of altering the font and the spacing dimensions. The validity of the chosen methods and an awareness of possible threats to the reliability of the data have been aired. General ethical issues were discussed in terms of protecting the anonymity of participants and confidentiality as regards information and data, but also more specifically in terms of responding to issues that might arise due to the participants having a diagnosis of dyslexia. These issues related in particular to weaknesses in language processing, reading inefficiency and understanding. It was therefore essential that safeguards were put in place to ensure participants clearly comprehended all information relating to their involvement in the study and that they made fully aware of their rights as a participant (see Ethics Form: Appendix 1). Finally, the sample group was introduced; methods and justification for choosing the participants, as well as the materials for testing and the procedure for collecting the research data.

The findings of the research are discussed in the following chapter. These are presented in pictorial format to allow for easier identification of patterns and themes in the data. The chapter is sub-divided in terms of the research aims, areas tested; reading speed and errors, as well as offering discussion on possible explanations for results found.

Chapter Four: Analysis of the findings

Introduction

Within this chapter, I discuss and analyse my research findings in response to my research aims. These aims are presented below as a collective and adhered to when interpreting the findings, whilst taking note of any themes that have emerged. The data has been presented in pictorial format (with a bar graph and pie chart) to allow this to be represented in a clear and concise manner, allowing for easy visual comparison between participant performances, their reading speeds and also errors made whilst reading.

Each participant's reading speed was initially worked out in terms of how many words per minute that they were able to read orally. Their reading speed in words per minute was then considered against the SpLD Test Evaluation Committee (STEC) guidance. Whilst the STEC guidance suggests that 'undergraduates should be able to read aloud at 150 words per minute' (DfES Guidelines, 2016, p. 5) it is acknowledged that this merely provides an 'expected' average reading rate for oral reading, rather than stating this to be a statistical conclusion. It was therefore important to also consider this information more holistically, both in terms of the reading rate (given as a standard score), as well as in relation to the nature of errors made by each participant. It was thought that this would give more context to the findings and allow for a greater understanding as to the nature of the scores.

Research aims

- To establish the historical emphasis of the literature in comparing the relationship between language-processing and visual-processing in dyslexia
- To identify the causal and influencing factors thought to be responsible for reading difficulties associated with dyslexia, particularly considering the role of visual aspects in reading development
- To investigate how altering the aesthetics of a page of text may affect the reading performance (reading speed and accuracy) of individuals with dyslexia

Part one – reading speed, unmodified text

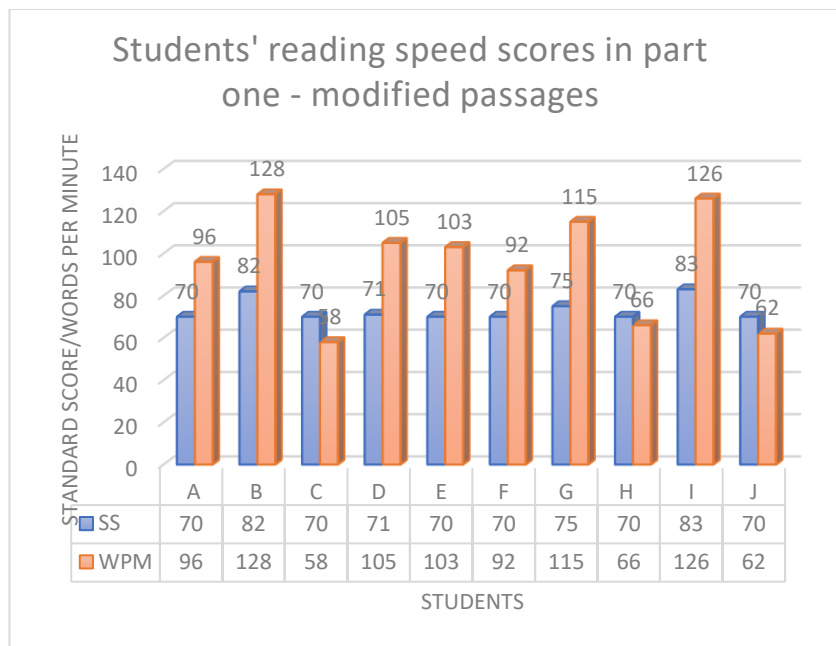


Fig. 3. Reading speed performance of dyslexic participants in part one

Performance as individuals

There are some interesting contrasts to be observed by individuals within the participant group, especially in terms of how many words per minute each participant was able to read orally. Specifically, participant B and participant I were established to have read the most quickly in the group; in part one participant B reading at a speed of 128 words per minute and participant I reading at 126 words per minute. It should be acknowledged here that whilst this is the case, their scores nonetheless still fall below the ‘expected’ reading rate mentioned above and relating to STEC Guidance (2016), which suggests a guide of 150 words per minute for oral reading rate.

In contrast to the quicker reading rate of participants B and I, three participants; C, H and J were seen to read the most slowly. Their scores when looked at in terms of how many words per minute they were able to read orally showed their reading to be more than twice as slow as that suggested by the 2016 STEC Guidelines. This shows their reading speed to be significantly below average.

Performance of the participant group

The participant group as a whole were found to have read below the expected oral reading rate of 150 words per minute and therefore placing them in the below average range for reading aloud.

Part two – reading speed, modified text

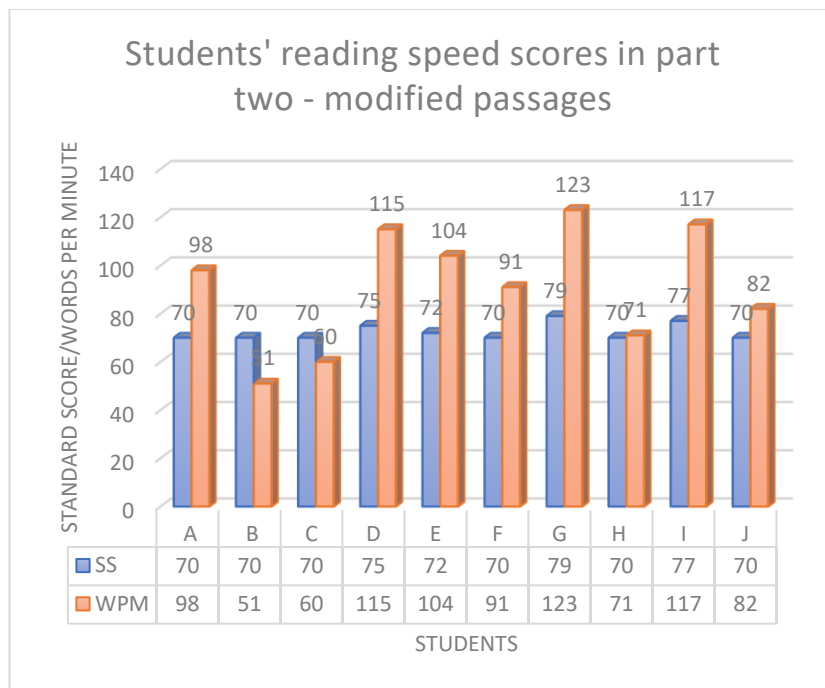


Fig. 4. Reading speed performance of dyslexic participants in part two

Performance as individuals

With the administering of part two this prompted a closer analysis of the data generated to establish if the reading rates of two participants in particular (participants B and I) had improved still further as a result of the text modifications. The results were unexpected in light of being provided with the modified text. It was thought that this might result in a faster reading rate than that seen in part one. Interestingly, their speed of reading was seen to be slower when they were presented with the passages that had altered font and spacing; in part two participant I was observed to read relatively slower than was recorded in part one, whilst participant B was seen to read at a rate that could be described as being significantly slower.

Performance of the participant group

Of the participant group seven out of the ten participants were found to have read faster when they were presented with the modified passages in part two; these participants being; A, C, D, E, G, H and J. This shows that in the majority of cases, reading of the modified text could be associated with a faster reading rate.

Part one – errors, unmodified text

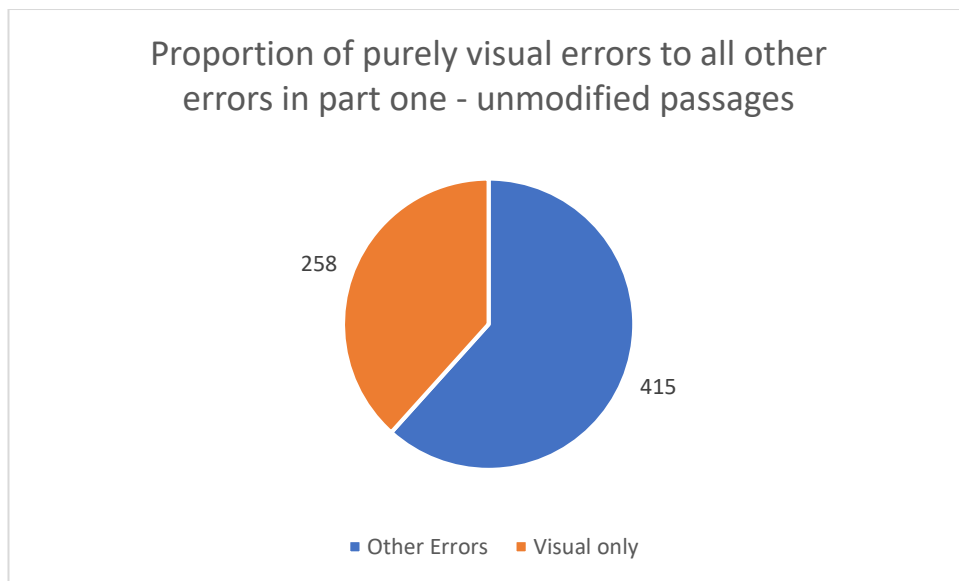


Fig. 5. Purely visual errors to all other errors in part one

Performance as individuals

Analysis of individual performances found only one to be of specific interest; that of Participant H. Participant H especially was seen to have made the greater number of visual errors in part one; a total of 66. These errors were observed as a result of completing the error analysis table, with participant errors being recorded under the categories of meaning, syntax and visual errors (Appendix 5). This score is worthy of note as it shows quite a significant amount of errors to have been of a visual nature, when compared to other errors made. Suggestions as to why visual errors may occur are discussed in the chapter summary.

Performance of the participant group

In part one the participants observed as a group were seen to make 258 purely visual errors. These visual errors made up around one third of all errors when reading; a significant amount (fig. 5).

Part two – errors, modified text

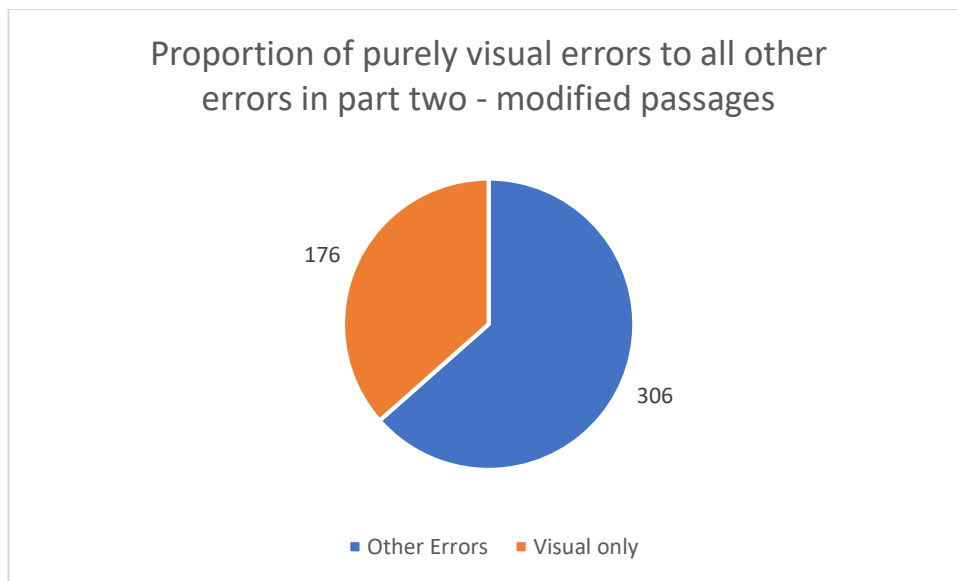


Fig. 6. Purely visual errors to all other errors in part two

Performance as individuals

In order to try and establish why participant B in particular may have read significantly more slowly than the others in the group when given the modified passages, the data was further analysed in relation to the nature of errors that were made. This established participant B in part 2 to have made less hesitations when reading, whilst they were additionally noted to self-correct any errors they made more readily than they were seen to do in part one. General scrutiny of their reading performance in part two found that they made less visual-type errors overall (fig. 6).

It was also established that four of the participants' reading performances showed them to have made less errors of a visual nature, as a result of being presented with the modified passages. Participant H in particular was seen to go from making 66 visual errors in part one, this number then dropping to 20 errors made, as a result of reading the modified text.

Performance of the participant group

When looking at the participant group performance overall the modified text given in part two could be seen to associate not only with less errors being made overall, but also less errors that could be correctly classed as being purely visual-type errors (fig. 6). To summarise, the results seem to suggest that the group as a whole were able to read more quickly with the modified passages of part two. Not only did this appear to associate with improvements seen in visual errors, but also improvements were seen across all other errors types as well.

Analysis of reading speed and errors

A decision was made to combine the aspects of reading speed and errors within this analysis section for discussion. This was due to these aspects often tending to co-exist and therefore it became difficult to single out and discuss these as separate entities.

Whilst the reading rates of participants were seen to vary, the data established the reading rates of all participants to be below average when compared to the expected oral reading rate of 150 words per minute suggested in the 2016 STEC Guidelines. This was the case in part one and part two of the research. A slower reading speed is likely to impact on a person's ability to attain a certain level of fluency that is considered necessary in order to realise reading for meaning. The achievement of a faster reading speed overall can be linked not only to improved reading fluency, but also more efficient processing ability, together with a greater understanding of, and engagement in the text. (Jones and Kindersley, 2013). Also of consideration, is that a faster and more fluent reading ability is likely to support motivation and an ability to maintain concentration on the task, rather than simply becoming a passive reader (Diemand-Yauman et al., 2010).

Additionally, the data found the participant group as a whole to have read faster when they were presented with the modified text given in part two. As well as this, they were found to make less purely visual errors. This is important when considering the aims of the research as this establishes there to be a positive association between modifying the printed page in terms of font and spacing, with improvements then seen within reading performance. This can be positively linked with the findings of Cornhill et al., whose primary interest was how a page of text might be perceived by the reader, in other words whether visual confusion may be seen to occur, such as blurring or print movement (1991). Also worthy of note is that whilst there were distinct improvements seen in errors of a purely visual nature, improvements were also made across all error types (including those which are considered to be phonological in nature). This appears to suggest in this case of this study that modifying the font and spacing facilitated easier processing of the text for students with dyslexia, with the result being that the participant group on the whole were observed to read with greater fluency and improved accuracy (this being seen through the recording of less errors in part two). The value placed on the impact of word and letter spacing was seen through research carried out by Reynolds and Walker, however their findings established benefits to be seen more readily through spacing of letters, rather than that of words (2004). In my professional role I often find it to be the case that slow, or laborious reading has implications for slower processing of text-based information and a resulting lack of fluency when reading. However, in contrast, if reading too quickly (some students can display a degree of impulsiveness in their reading performance) this can result in missing, or mixing words or punctuation marks. This can associate with errors being made such as; losing their place easily, skipping over words or lines, adding in, or omitting

letters, e.g. as in reading tail for trail. I have also found that students are often likely to guess at a word if unsure.

It was established in part two that participant B read more slowly. When compared to the other participants' performances, this was unexpected. Nonetheless, participant B appeared to be less hesitant in their reading, they were positively observed to self-correct and they made less visual-type errors. One reason for this may be that as a result of the modifications made to the text in part two this prompted participant B to read more slowly, and importantly, encouraging a more considered reading performance. Participant B's reading here can be contrasted with Diemand-Yauman et al's research (2010) which explored the theory that hard-to-read fonts may actually serve in improving reading performance. With participant B the opposite would seem to be the case; with text that may be understood to be more difficult to process (as would be the case with the unmodified text given in part one), then in Diemand-Yauman's view this could be thought to prompt deeper cognitive processing to take place. In participant B's case it may be that the opposite actually occurred, in that with the unmodified text being more difficult to process, this served instead to inhibit efficient reading ability. Whether a student was seen to read faster, or slower when presented with the modified passages in part two, in my professional experience I am often mindful that reading speeds can be affected by whether a student anticipates comprehension questions, or some other task to be given afterwards. In other words, this anticipation may result in a more considered and generally slower reading speed, or, in contrast it can happen that a student is more likely to skim over the general detail of the text, focusing their greater attention on to key points, that they predict may link to questions asked. This could likely result in a faster reading rate.

The results were especially interesting in that they established there to be a high number of visual errors that were seen to occur when reading. Whilst additional errors, such as those of a phonological nature were also present the proportion of visual errors was unexpectedly high in light of past research which has tended to be more focused on the phonological factors, in turn often dismissing the significance of visual factors. An example of this can be seen in the Rose Review's definition of dyslexia which sees phonological abilities to be central and characteristic to a profile of dyslexia (2009).

The results of this study have found that when modifying text, not only were visual errors reduced but also all other errors (including phonological). These results do not seek to dismiss the importance of all influences on reading accuracy, especially those expected errors from a phonological source, however the results also give good evidence as to recognising the significant impact of visual-type errors on the process of reading. This was also seen through Gori and Facoetti's research, who cited the dangers of focusing solely on phonological factors as a primary

reason for reading difficulties (2015). This relates to and goes some way to confirming earlier discussion concerned with the three-stage process of reading (and spelling) development (Frith, 1985). In particular, the importance of the third stage in development where earlier sight-reading skills (logographic) are seen to consolidate with second-stage awareness of sounds (alphabetic) and result in the orthographic stage. The orthographic stage is an essential stage where both visual and sound-based skills combine, enabling fluent and accurate reading to take place (Jones and Kindersley, 2013). In trying to establish a reason for this research study to have found a distinct reduction in all errors as a result of changes made to the perceptual properties of the text passages, one possibility could be that this enabled the orthographic stage to happen more efficiently than might otherwise have been the case. For instance, by facilitating the clearer processing of a page of text, a participant may have been able to sound out the first syllable and on hearing this, able to then identify the whole word through visual recognition, rather than simply relying on guessing. Therefore, enabling both skills (visual and phonic) to work simultaneously for more efficient reading to take place. The Rose Review's definition of dyslexia (2009), whilst recognising that dyslexia can be seen to affect necessary skills for reading (accuracy and fluency), in doing so it does not appear to fully acknowledge the importance of the orthographic process and the equal role of the visual skills that are required for this process to take place.

The results found here strike a positive comparison with the reasoning behind the spacing and typesetting to be found in children's books, which is not only traditionally made to be larger and looser but also to serve the distinct purpose of aiming to make the print easier to read (Reynolds and Walker, 2004).

Summary

In my experience as a dyslexia assessor there can often be a number of reasons for visual errors to occur, such as word guessing. Rather than using decoding skills it can be more common for a student with dyslexia to learn frequently-used words by sight, as whole words. This means that they will often memorise these in their visual dictionary, for easier recognition when reading (Jones and Kindersley, 2013). In my role as an assessor I find in some cases that good scores can be achieved through an over-reliance on sight-vocabulary. This may lead to guessing at a particular word instead. Guesses may sometimes be based on what the initial letter might be, or on the word shape as a whole. As a compensatory strategy this can sometimes be seen to heighten performance, however masking difficulties that may be present in underlying skills, such as in the phonological areas. As a consequence, as students come across more challenging or unfamiliar vocabulary, such as technical course-related terms, this strategy can then become untenable.

This chapter established the findings of the research, through the reporting of patterns noted in the data and also in seeking to interpret the evidence. In doing so, this helped to answer certain points prompted by my research questions. What have I found to be the causal and influencing factors of reading difficulties? Whilst research is clear on the importance of phonological factors in the process of reading, my own research suggests that the visual aspects have a greater significance than might previously have been acknowledged. Also, through altering the visual look of a page of text-based information this was seen to positively associate overall with a faster reading speed and improved error rate. Most importantly, it could be assumed that by changing the perceptual properties of a page of text-based information then this may increase its readability. One suggestion for this may be that this allows both visual and phonic skills to work simultaneously, resulting in better word recognition.

The next and final chapter draws together what has previously been looked at and discussed throughout this study. I consider my own research, together with that presented by the literature to see how far this goes in being able to answer my research questions. Recommendations as a result of this research are also presented here.

Chapter Five: Conclusions and Recommendations

How Altering Letter Size and Spacing in Text can Affect Reading Speed and Accuracy for Students with Dyslexia

Introduction

This chapter reviews the outcomes of the study and makes a final reference to the aims and to the relevant literature. The first part of this chapter is organised under each of the research aims in aiming to answer these as fully as possible. Next, some recommendations are outlined following the results of the research in terms of practical strategies to support inclusion in the classroom, as well as through individual support. Thoughts on how the undertaking of this study may have benefits for my own professional and personal development are discussed, in addition to how the findings of the research can be best disseminated to others. Finally, the results of the study are evaluated and thought given to further research opportunities.

Aims

Research Aim One

To establish the historical emphasis of the literature in comparing the relationship between language-processing and visual-processing in dyslexia.

Examination of the literature found that in trying to establish an understanding of the roles of language-processing and visual-processing, opinions appeared to vary. Whilst a number of previous studies have tended to lean more towards the phonological aspects as having greater prominence in the reading process, so too have emerged studies with a specific focus on looking at the visual aspects. The motivation for concentrating on the visual aspects has tended to emanate from the areas of optometry, physiology and neuroscience (Stein, J., West, O., Walsh, V.). In addition, another field of thought has resulted from the world of typography (Reynolds and Walker, 2004) and graphic design, from which evolved the creation of the Dyslexie font by graphic designer Christian Boer. The results of my own primary research bear out the positives found in the research, in that the visual aspects should be lent importance in the role of processing when reading. As such, the evidence suggests that they should neither be dismissed or their significance minimised.

Research Aim Two

To identify the causal and influencing factors thought to be responsible for reading difficulties associated with dyslexia, particularly considering the role of visual aspects in reading development.

This study highlighted the potential for improving learners' performance through presenting reading material in a format which allows for easier accessibility. Nonetheless, it is also important to acknowledge that whilst the main focus of the study was on performance in terms of reading fluency, in contrast, it did not deal with pinpointing such specifics as; at what point formatted material might become easier to read (be this to do specifically with line, or letter spacing, or font style), or even whether a more accessible font might also lead to establishing a deeper comprehension and retention of the given text. With this in mind, the positive effects of this study in linking use of modified text with a better reading performance are of significance in the future when considering the format of text-based learning materials for dyslexic students. However, the research could now be moved on a level to consider and encompass some of the points raised above to provide a more individualised view of the difficulty.

Analysis of the data resulting from the reading of the modified passages (part two) found there to be, in most cases, an improvement in the reading speed of the participants. In addition, improvements were to be seen in the number of errors they made whilst reading. What was not considered initially was whether improvements might be seen across all types of errors, not just in visual errors (and including those of a phonological nature) by modifying the text and spacing. This is exactly what happened. What can be concluded from this is that whilst improvements were found to occur in purely visual-type errors, use of the modified text was also seen to have possible benefits for improving other types of errors as well. The implications of this being that it can be presumed that the changes that were made to the text (in font and spacing) allowed the efficient combination of both skills; visual and phonic (orthographic stage) to happen, with one skill being dependent on the other for more effective reading performance.

Research Aim Three

To investigate how altering the aesthetics of a page of text may affect the reading performance (reading speed and accuracy) of individuals with dyslexia.

It is also important to recognise that whilst improvements were acknowledged to exist across the participant group as a whole, this was by no means the case with each individual participant. This serves to highlight the individuality of students with dyslexia and to exercise some caution in not assuming a 'one size fits all' approach. In fact, the range of ability and attainment found in Further and Higher Education can be vast.

Particularly significant is that on the whole, using larger spacing and text has tended previously to have been the domain of children's literature, or simply for those who have visual impairments. Whilst acknowledging that past research has established that increasing the font size for example, can result in improvements in reading attainment (Wilkins et al, 2009), the results of this research recommend there to be a more widespread approach towards adapting text-based information.

This could go some way towards supporting more efficient visual processing ability and hopefully support improvements in reading performance for those with dyslexia.

Recommendations

There are positive implications as a result of the findings of this study for how lecturers might choose to present the format of teaching and learning aids/materials i.e. PowerPoints, or the layout of hand-outs of essential course information for those with dyslexia, with an aim to making it more accessible. A guide of recommendations for document formatting could be provided and placed for easy access by lecturers / support staff. This could be located for instance, on the organisation's Portal pages. Students should also be made aware of these recommendations should they choose to adapt their own documents:

- Use a dyslexia-friendly sans serif font consistently in a document, such as Verdana, Arial, Comic Sans, or Trebuchet
- Increase the spacing of text-based documents, so as to create double-spacing between words
- Increase the font size to a suggested 14 point
- Justify the text
- Allow extra processing time when reading for those students with dyslexia
- Encourage students with diagnosed visual stress difficulties to use their coloured overlay over reading material. This can help alleviate problems such as high contrast that occurs as a result of black print on white paper

Or, print onto coloured paper / change the background colour of computer page

The importance of miscue analysis

The importance of miscue analysis as a method of examination has been backed up by the results of this study. It has enabled the source (errors) of a participant's reading difficulty to be carefully studied, helping to answer specific questions as to their patterns of errors, as well as suggesting the nature of the teaching instruction going forward. In knowing the errors possible reasons for having a slower reading performance can be established, whilst there are also other areas of performance that can associate with having visual-type errors when reading. It may mean that a student has to reread a passage a number of times over to remember specific details, or to comprehend the information easily. In my professional experience this can mean that they can have a weak spontaneous recall of what they have read. If they have difficulty tracking print accurately then this can result in misreading words, often those which may be already familiar to them. Recognition of words can be weaker and therefore problems with mixing visually-similar looking words can occur, such as reading 'house' for 'horse'. As a tool for understanding the area

of difficulty is important in being able to move forward confidently with explicit teaching instruction. It is important to establish what they do well when reading, as well as what is done with difficulty, how they are processing the text and also what they tend to do when they come across difficulty (such as guessing at words). Only then can it be established what they need to practice and to learn going forward.

Professional Development

In undertaking this research, it has made me more aware of the importance of establishing background information on students' ability, such as when they are reading. Having spent time in analysing the patterns of their errors this has helped to suggest the nature of my teaching instruction and the specific areas to focus on, going forward. This has allowed me to consider what kind of reader and learner they are so that I have more insight to be able to individualise their support intervention.

Personal Development

The undertaking of a study at Master's level I feel has improved my knowledge and understanding of my chosen subject area and given me more confidence in being able to communicate this to others within my organisation, such as when delivering dyslexia awareness training sessions for staff and PGCE students.

Recommendations

There are positive implications as a result of the findings of this study for how lecturers might choose to present the format of teaching and learning aids/materials i.e. PowerPoints, or the layout of hand-outs of essential course information for those with dyslexia, with an aim to making it more accessible. A guide of recommendations for document formatting could be provided and placed for easy access by lecturers / support staff. This could be located for instance, on the organisation's Portal pages. Students should also be made aware of these recommendations should they choose to adapt their own documents:

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- Encourage students with diagnosed visual stress difficulties to use their coloured overlay over reading material. This can help alleviate problems such as high contrast that occurs as a result of black print on white paper

Or, print onto coloured paper / change the background colour of computer page

Dissemination

As mentioned above, there will be opportunities within my organisation to be able to disseminate my knowledge from this study, along with positive recommendations for the supporting of reading difficulties of dyslexic students. These opportunities will arise through the delivery of twice-yearly staff dyslexia awareness training sessions, smaller ‘How to’ sessions, regular mentoring sessions with a colleague and also through fortnightly Specialist Support Team meetings.

Evaluation and suggestions for further research

Whilst speed of reading has been a focus of this study, this alone is not a skill that fully supports reading comprehension. Instead it is part of a cluster of skills that when working together efficiently enable reading for meaning to take place (Rasinski, 2006, cited in Cotter, 2012). Therefore, in order to progress the findings of this current study, it is recommended that any future research also considers the effect that modified text has on reading comprehension. There are a number of standardised reading comprehension tests available to do this such as the WIAT-11-T (Wechsler Individual Achievement Test), or The ART 2 (Adult Reading Test). These tests are adult-normed, in other words, they have been correctly standardised on the adult population.

To provide some further validity to the current research results and to build on what has been found here, additional research with use of a larger sample set is recommended, this having only been a small-scale study.

Summary

This study explored the reading performances of dyslexic participants on an oral reading task, repeating the task again one month later but with modifications made to the font and spacing. My first aim was to gain an understanding of the view of the literature as regards the role of language and visual processing during reading. My second aim was to try to identify those factors thought to cause or influence reading difficulties, with a particular interest in the visual aspects. Thirdly, my primary research enabled me to see what direct effect might be had by changing the text modifications; larger font and spacing. In other words, whether the participants were able to read faster and with more accuracy as a result. Whilst there were individual variations my results found that the participant group as a whole showed improved reading speed and a reduction in

inaccuracies were noted in reading performance, due to the altered text. A number of errors were also of a visual nature and these were seen to reduce as a result of the text modifications. Other errors were also seen to be reduced as a result of the text changes made. This justifies reading to be a complex task, particularly for those with dyslexia and one which requires an efficient combination of visual and phonological processing to take place. This study sought to promote the importance of the visual aspects in the process of reading, however it also established that for more efficient reading ability, the visual skills need to be working in conjunction with the phonic skills and therefore enabling the orthographic stage to occur. This was thought to have been assisted in the case of this study through enabling the participant easier processing of the page – through changes made to font and spacing.

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