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A Quantitative Study Identifying the Prevalence of Anxiety in Dyslexic Students in Higher Education

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Abstract**—**Adult students with dyslexia in higher education can receive support for their cognitive needs but may also experience negative emotion such as anxiety due to their dyslexia in connection with their studies. This paper aims to test the hypothesis that adult dyslexic learners have a higher prevalence of academic and social anxiety than their non-dyslexic peers. A quantitative approach was used to measure differences in academic and social anxiety between 102 students with a formal diagnosis of dyslexia compared to 72 students with no history of learning difficulties. Academic and social anxiety was measured in a questionnaire based on the State-Trait Anxiety Inventory. Findings showed that dyslexic students showed statistically significant higher levels of academic, but not social anxiety in comparison to the non-dyslexic sample. Dyslexic students in higher education show academic anxiety levels that are well above what is shown by students without dyslexia. The implications of this for the dyslexia practitioner is that delivery of strategies to deal with anxiety should be seen equally as important, if not more so, than interventions to deal with cognitive difficulties.

Keywords**—**Academic, anxiety, dyslexia, quantitative, students, university.

I. Introduction

IF negative emotional consequences of dyslexia are exacerbated, this may prevent the dyslexic higher education student from successful completion of their chosen course of study and could have a more harmful impact on student progression than the cognitive deficits associated with dyslexia. Carroll and Illes's UK study assessed the prevalence of anxiety in 16 students with dyslexia compared to 16 students with no history of learning difficulties [1]. A questionnaire was used to measure three specific areas of anxiety – academic, social, and appearance. Students were then given a timed reading test, using the Test of Word Reading Efficiency and their state anxiety levels were measured using the State-Trait Anxiety Inventory [2], [3]. The results indicated that dyslexic students showed slower reading speeds than their controls, but more importantly for this paper, findings revealed that dyslexic students had higher levels of state anxiety (fear, nervousness, discomfort induced temporarily by situations perceived as dangerous) and elevated levels of academic and social, but not appearance anxiety. Although the sample size used by Caroll and Illes was small, dyslexic students (N = 16) and a comparison group of non-dyslexic students (N = 16), they argue that dyslexic students in higher education show anxiety levels well above what is shown by students without reading difficulties and the anxiety is not solely limited to academic tasks but extends to many social situations.

This study aims to extend the findings of previous work by Carroll and Illes with a larger sample to clarify whether students registered as dyslexic at university are still vulnerable to high levels of academic and social anxiety in comparison to their non-dyslexic peers [1]. Based on previous findings, it is expected that dyslexic students will show higher levels of academic and social anxiety. The hypothesis to be tested for the study is: adult dyslexic learners in higher education have a higher prevalence of academic and social anxiety than their non-dyslexic peers.

A. Academic Anxiety and Social Anxiety

Anxiety in the context of the study is defined as academic anxiety, which specifically is anxiety connected to and affecting academic performance, and social anxiety referring to the fear of social situations involving interaction with other people [4], [5]. In this context, social anxiety is connected to the academic environment only and situations, such as seminar debates, presentations, etc. Thus, in the use of academic and social anxiety in the study, at no point is this referring to clinical anxiety and the sample used for the study has not included adults with a formal diagnosis of generalised anxiety disorder.

B. State and Trait Anxiety

Anxiety, whether academic or social, can be divided into the categories of state and trait anxiety. The state-trait model of anxiety [6], a psychological model consisting of 40 self-report items pertaining to anxiety affect, has been administered in many studies for the purposes of measuring the two types of anxiety within various groups [3], [7]-[8]. State anxiety describes the experience of fear, nervousness and discomfort induced temporarily by situations perceived as dangerous whereas, trait anxiety refers to a more stable tendency to experience fear, worry and anxiety across many situations.

II. Previous Research on Dyslexia and Emotional Consequences

Fruitful studies in the area of comorbidity, defined as co-occurring difficulties between literacy and externalising disorders – mental disorders characterised by maladaptive behaviours directed towards an individual's environment, have included research looking at high levels of comorbidity between literacy difficulties and psychological disorders in children. For example, the association between reading

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difficulties and the elevated risk for externalising disorders, such as attention-deficit hyperactivity disorder (ADHD), has been consistently reported [9]-[14]. Additionally, there is also evidence of the relationship between reading difficulties and Conduct Disorders (also referred to as anti-social behaviour disorders) [9], [12], [15]-[17]. The comorbidity between literacy and language difficulties and emotional and behaviour disorders (EBD) in children has also been documented [18]-[25] whilst Lawrence investigated levels of self-esteem in children with reading difficulties and reported that poor readers had lower self-esteem compared to controls [26], [27]. The earlier study advocated an approach which taught basic literacy skills and nurtured self-esteem through counselling, as a more effective method to remedy this, than the more singular focus on literacy skills development [26]. In relation to anxiety, some studies have used self-report measures to look at differences between sample groups of dyslexic children compared to controls and have found significantly more anxiety in children with learning disabilities than the control groups [28], [29].

A few studies have suggested a strong association between dyslexia and internalising disorders [30]-[35]. For example, anxiety-related symptoms, such as lack of concentration, lack of interest and attention, distraction, emotional distress, tension, day-dreaming, phobias, fear of rejection, insecurity, aggressiveness, withdrawal and psychosomatic complaints have been common findings in case studies of children and adolescents with dyslexia who have taken part in various research studies in the twentieth century [36]-[42]. Whilst this literature provides some evidence that dyslexia is associated with internalising problems (depression and anxiety) in children, directions of causality are not clear. Furthermore, valuable work has also been undertaken on adolescents with dyslexia and the emotional consequences of negative experiences in education before HE level. For example, Burden's in-depth study of 50 adolescent boys attending an independent specialist school for dyslexic children focused specifically on dyslexic adolescents' feelings of learned helplessness, self-efficacy and locus of control [43]. Burden found that although the boys' initial academic self-concept was significantly lower than that found in the mainstream standardization sample, this increased as the boys moved up the school. Even more significantly, however, he also found very little evidence of learned helplessness and a high degree of self-efficacy and internal locus of control. Burden claims that these findings raise "the further issue of the context in which the dyslexic boys were being educated. It was clear that the ethos of the school in this case was one that was success orientated, and that attribution retraining, albeit at an implicit level, focused on effort and agency rather than notions of ability and this underpinned all aspects of the pedagogy" [43, p.194]. However, this work is focused specifically on adolescents and further work of this nature is now required to look at adult dyslexic students and the association with internalising disorders within the context of university.

A. Studies on Comorbidity between Dyslexia and Internalising Disorders in Adulthood

The studies mentioned above demonstrate that although there is now a growing amount of research on the connection between dyslexia and externalising and internalising emotional difficulties in children and adolescents within school, there is little research looking at these relationships in adulthood and the university environment. The small number of studies having looked at this have found that university students with dyslexia report higher levels of somatic complaints, social problems, lower self-esteem, and higher depression scores than their peers [44], [1], [45]. Other limited studies in the area have looked at dyslexia and anxiety in specific subject areas, such as math and statistics, and in relation to specific study tasks, such as exams and timed tests [46], [47].

Riddick et al. investigated whether dyslexic adults' levels of self-esteem and anxiety are impinged when in high-literacy-demand situations [44]. Their UK study used a sample of 16 dyslexic students aged between 18 and 42 compared to 16 non-dyslexic students with ages ranging from 19 to 35 to examine this. The dyslexic and control groups were asked to complete the Culture-free Self-esteem Inventory, the State-Trait Anxiety Inventory and a questionnaire created by the research team which asked about various aspects of their educational experiences [48], [3]. Their results revealed that on the Culture-free Self-esteem Inventory the dyslexic group had significantly lower self-esteem scores than the control group. Additionally, they comment that the low self-esteem of the dyslexic students fits with the overall picture given of their individual past and present learning experiences in the questionnaire [44].

Jordan et al. asked 28 undergraduate students with dyslexia and 71 undergraduate students without dyslexia to complete a series of scales and questionnaires [46]. Having a diagnosis of dyslexia was associated with higher mathematics anxiety and, in addition, to having greater levels of worrying, denial, seeking of instrumental support and less use of the positive reinterpretation coping strategy (making the best of the situation by growing from it). This study is limited by focusing specifically on the subject area of mathematics, which now needs to be extended to investigate the extensiveness of anxiety with a varied array of subject areas and academic tasks.

Nelson et al.'s US study examined levels of test anxiety amongst 50 college students with dyslexia compared to 50 college students without dyslexia [47]. Again, a series of scales and questionnaires was used including the Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV) as the authors wanted to explore within both the dyslexic and non-dyslexic groups, the relationships of cognitive abilities (i.e. general intelligence, verbal ability, non-verbal ability, working memory, processing speed, reading skills) and consequences for test anxiety, which is a combination of physiological over-arousal, tension and somatic symptoms, along with worry, dread, fear of failure, and catastrophising, that occurs before or during test situations [49]. Results suggested that college

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students with specific reading disability (RD) (dyslexia) reported higher levels of test anxiety than those without RD, and from the cognitive constructs measured, it was found that lower scores in non-verbal ability and working memory correlated with higher levels of test anxiety. Similarly, to the critique of the Jordan et al., as it has narrowly focused on anxiety in relation to only one topic, mathematics, a critique of the Nelson et al.'s study is that the work has a narrow focus in that it has looked at only one type of academic task, namely tests [46], [47]. This work now needs to be broadened by investigating the presence of anxiety, or of other negative emotions that the dyslexic learner may have with other varied forms of study tasks and assessment methods frequently administered by higher education institutions.

A recent UK study carried out by Stagg et al. used a mixed method approach to look at self-efficacy (which refers to an individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments) in undergraduate students with dyslexia [50]. The study compared a sample of 22 undergraduate students with dyslexia between the ages of 18 and 32 years, with a sample of 22 undergraduate students without dyslexia also aged between 18 and 32 years. The first quantitative stage of the study involved participants completing two scales: an eight-item academic self-efficacy scale designed to cover a variety of skills relevant to academic achievement, followed by a 32 item sources of academic self-efficacy scale, which consisted of four subscales tailored to measure four sources: past achievements, vicarious experience, social persuasion, and psychological state. The second qualitative stage included undertaking non-directive semi-structured interviews with four dyslexic students and four non-dyslexic students. The interview approach used was deductive as the interview protocol was developed using Bandura's four sources of self-efficacy as a theoretical framework to explore the development of student's academic beliefs [51]. Findings revealed that there was a significant difference between the dyslexic and non-dyslexic samples on both the self-efficacy scale with non-dyslexic students' scores being significantly higher than the dyslexic scores meaning that dyslexic students have less belief in their ability to academically succeed than their non-dyslexic peers. Stagg et al. report that "of note were the low scores reported by students with dyslexia on the measure of 'physiological state', which measures physical and emotional discomfort in academic situations, and demonstrates that being dyslexic continues to have a negative psychosocial impact even in higher education" [50, p.36]. Additionally, the interviews revealed two main themes prevalent in the dyslexic sample as compared to the non-dyslexic sample: ability awareness; students with dyslexia seemed to be aware of their academic weakness; and the negative impact of past schooling and experiences from school on the development of self-efficacy. This study is progressive. The combined method of following up on quantitative data through qualitative interviews, to establish that differences between self-efficacy scores of the two groups may be connected to the dyslexic sample focusing more on academic weaknesses and negative previous school experiences, has added prominence and meaning to the quantitative results through adding an extra layer of understanding. The interviews have also provided an outlet for the dyslexic undergraduate student voice in relation to barriers to self-efficacy to be heard. Stagg et al. claim that the findings suggest university students with dyslexia still need interventions to help boost their self-efficacy profiles, despite the level of success they have achieved in gaining a place at university [50]. Furthermore, the limited research on dyslexia and emotional consequences, whilst providing evidence regarding the comorbidity between reading difficulties with externalising and internalising disorders, has primarily focused on children and adolescents, with a disregard in relation to how this potentially maps out onto an adult dyslexic learner and continues into adulthood in the form of internalised anxiety at university level education. In addition, the few studies that have been conducted in this area have typically used small samples which makes the work difficult to generalise [52], [1], [46], [44]. Additionally, these studies tend to be single method, principally quantitative and as such, results have not been followed up on a deeper level through the method of qualitatively validating further and triangulating the quantitative findings through interviews with participants [52], [1], [46], [47]. Despite these criticisms, these studies have provided a foundation for this research in implying that it is now necessary to investigate on a bigger scale whether dyslexic adult learners do in fact require more ongoing emotional support in relation to their studies, and to identify what they themselves are doing, if anything, to cope with the negative emotional consequences, such as anxiety whilst studying with dyslexia.

III. Theories of Anxiety

Theoretical approaches to anxiety fall into the broad categories of psychoanalytic [53], [54]; learning/behavioural [55], [56]; physiological [57]-[59]; cognitive [60], [61]; and uncertainty [62], a theoretical concept that threads through all of the above categories. Freud viewed anxiety as an everyday phenomenon and as a way of explaining neuroses [53]. His first theory regarded anxiety as being a transformed libido with the transformation occurring due to repression. Thus, if a person is prevented or thwarted from carrying out some instinctive (sexually driven) act through repression then the consequence is anxiety [63]. Freud used the example of the threat of the loss of the mother and separation of the mother and the implications of this for the developing child as a way of explaining anxiety. Freud's second theory reversed the repression-anxiety connection and instead regarded repression as a consequence of anxiety. For example, in this conceptualisation, anxiety is a signal from the ego about real, existing, or potential danger. The unpleasantness of the threat causes anxiety which then leads to repression as a way of getting the person out of danger [63]. In this scenario, a dyslexic student may have an anxiety signal from the ego about the potential danger of ensuing exams, or presentations. The unpleasantness of the threat of exams then leads the student to repression, i.e. not participating in the activity as a

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way of escaping the danger. Later psychoanalysts, such as Sullivan unlike Freud's focus on separation anxiety, instead emphasised social environment as cause of anxiety [54]. For students with dyslexia, the university environment can cause levels of distress to the extent whereby they find it difficult to function within that setting.

The physiological theory of anxiety implies that responses within the body are responsible for emotions [57], [58]. Within this theory Gray focused on the behavioural inhibition system which he theorised as a neurobehavioural system responsible for regulating negative affect and avoidance behaviour in response to threats or punishment [57], [58]. Gray suggests that individuals vary in the sensitivity of their system and this is associated with the personality factor of neuroticism as underpinning anxiety. Other physiological theorists, such as Panksepp conceptualised anxiety as a fight or flight response, which is the instinctive physiological response to a threatening situation, whereby the person either resists forcibly, or runs away to avoid the danger [59]. Although physiological theory is interesting for explaining the bodily reactions to situations perceived as threatening, a more appropriate theory particularly for this study is the cognitive conceptualisation of anxiety [60]. Eysenck argued that the cognitive system acts as a gateway to the physiological system, so in attempting to understand anxiety, it is important to consider both systems. Eysenck's early experimental work went onto show that there are differences between people who are high and low in trait anxiety (stable tendency to experience anxiety across many situations) dependent upon the information that they have stored in long-term memory [64]. In his study of anxiety and the worry process, involving 44 participants selected due to their high scores on the trait measure of the State Trait Anxiety Inventory, he concluded that prolonged worry occurred mainly in those individuals who have highly organised clusters of worry-related information stored in long-term memory. In addition, Eysenck and Calvo demonstrated that those who are high or low in anxiety do in fact differ in the structure (content) and processes of cognition, which is further discussed below with the discussion on processing efficiency theory [65]. Ultimately, as noted by Strongman, what is important about Eysenck's theory of (trait) anxiety is that it draws attention to the importance of the cognitive system, as well as the physiological and the behavioural [63]. The cognitive dimension is also of importance when looking at the association between dyslexia and anxiety. As Eysenck reported in his study, individuals with higher levels of anxiety had worry-related information stored in long-term memory [64]. Adults with dyslexia commonly report negative school experiences associated with reading and these memories, re-activate when similar threatening situations from childhood arise, such as reading aloud in class and taking exams, which may induce anxiety [66]. This is consistent with Ohman's information processing model of anxiety, which is shown in Fig. 1 [61].

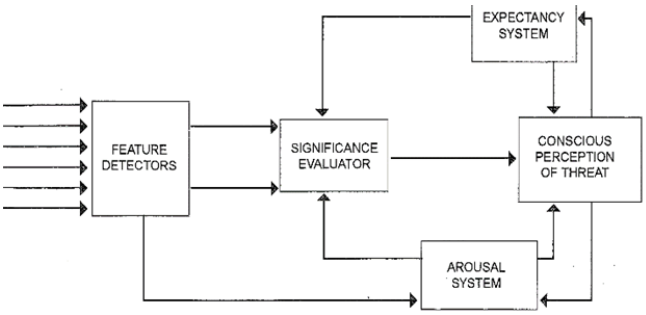


Fig. 1 Ohman's Information Processing Model of Anxiety [61]

As can be seen from Fig. 1, the model has five main processes. Stimulus information passes to feature detectors, which pass the information onto significance evaluators and the arousal system. The significance evaluators automatically evaluate the relevance of the stimuli. The meaning of the stimuli is analysed at this point and memory has an important part to play, which could be said to be an extension of Eysenck's work [64], [60]. The arousal system can also exaggerate the stimuli to influence the significance evaluator. The significance evaluator also provides input to the conscious perception system. The expectancy system, which is based on emotion being organised into memory, therefore biases the significance evaluator to react to information which matches active memory nodes. This in turn gives information to the conscious perception system. For example, the re-activation of negative emotions stored in memory influences the significance evaluators to perceive certain stimuli or information as threat. If a dyslexic student has stored into memory emotions of being ashamed or embarrassed from the experience of reading out loud at school, in later adult years when faced with stimuli, such as being asked by a Lecturer to read aloud in a seminar, the arousal system of the student magnifies the request. This influences the student's significance evaluator to regard the request to read aloud as threat, which inputs this threat to the conscious perception system of the student. Therefore, the student's expectancy system, as it is activated by negative emotional memory, biases the incoming information and makes a context for the interpretation of what goes into their conscious perception system. The conscious perception system is part of a much larger system incorporating the mind, consciousness, and the cognitive-interpretive system. It integrates input from the arousal system, the significance evaluators and the expectancy systems, and chooses suitable actions to deal with the perceived threat, in this case reading aloud, which may be through avoidance.

IV. Theories of Academic and Social Anxiety

Extensive work in this area has focused on theoretical models of test anxiety, these have included; the drive model [67], cognitive-attentional models which suggest that cognitively negative thoughts occur during assessments [68], [69], skills deficit models [70]-[72], the self-regulation model [73], the self-worth model and the transactional model [74],

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[75]. However, to understand the relationship between anxiety and general academic performance, Hadwin et al. proposed a theoretical model, the processing efficiency theory, or PET, which builds on previous processing models devised by Humphreys and Revelle [77]; Sarson [78]; and Eysenck and Calvo [65]. This literature argues that worrying about performance and/or evaluation results in less capacity in working memory for conducting academic tasks and activities. Working memory, as part of short-term memory is a cognitive system responsible for the transient holding, processing, and manipulation of linguistic and perceptual information [79]. As defined by Baddeley working memory has three components: a central executive, a phonological loop, and a visual-spatial sketchpad [79]. The central executive is responsible for the selection, initiation, and termination of processing information. This involves the tasks of encoding, storing, and retrieving information. The phonological loop deals with auditory and verbal information, such as speech. It also involves converting written words into speech and has the capacity to retain letters, words, and numbers. The visual-spatial sketchpad is responsible for remembering visual images and spatial position [80]. Hadwin et al. propose that worry over academic evaluation may use up the capacity of the central executive and the phonological loop components of working memory [76]. For instance, if task requirements make demands upon the central executive or phonological loop components of working memory, processing efficiency theory predicts that increased state anxiety will impair processing efficiency, i.e. how effectively the individual is able to deal with the requisites of the academic task. Furthermore, processing efficiency theory also postulates that increasingly complex tasks might also impact upon and impair academic performance in anxious individuals [76]. Consequently, processing efficiency theory may possibly provide a useful lens through which to understand the complexities of the relationship between anxiety, dyslexia, and academic performance in adults. Hadwin et al. investigated the processing efficiency capacity on the working memory of children by splitting 30 children aged 9 to 10 years into two groups; a low anxiety, and high anxiety group, based on results from the State-Trait Anxiety Inventory for Children [76]. The 30 children had no known diagnosis of specific learning difficulties or of dyslexia. The two groups were asked to undertake three different tasks requiring use of working memory. After completion of the tasks, they were assessed for task accuracy which was an indicator of performance outcome or effectiveness. "Time taken to complete the task and a subjective rating of mental effort were taken as measurements of performance efficiency" [76, p.379]. Although no differences were found between children in the high and low state anxiety groups in relation to task accuracy, there were differences between the groups in time taken to complete the tasks, with children in high state anxiety group taking longer to finish the backward digit span task. Additionally, children in the high state anxiety group also reported more increased mental effort in the forward digit span task than children in the low state anxiety group which indicates some effects of anxiety on performance efficiency. Hadwin et al.'s work has implications for students with dyslexia [76]. Anxiety when engaging in academic tasks may reduce efficacy for students with a diagnosis of dyslexia, who are already at risk of difficulties with working memory [81]. Academic tasks with high demands on phonological working memory, such as reading, which involves the encoding of phonological information, and examinations, both written and oral, requiring the storing and retrieving of information, may be particularly vulnerable to being affected by anxiety. Consequently, dyslexic students, who typically have had trouble with such tasks in the past, may feel heightened anxiety when undertaking these tasks which undermines their ability to perform at their best.

According to Trower et al. theoretical models of social anxiety have their origins in the behaviourist paradigm [82]. Trower et al. propose that people pursue social goals according to rules and monitor their performance in the light of feedback from the social environment [82]. Thus, behaviour such as avoidance or withdrawal is caused by, and is a response to, external/environmental stimuli. In the self-presentation model of social anxiety, anxiety arises when people are motivated to make a good impression on an audience, but doubt they will do so, and thus perceive or imagine unsatisfactory evaluative reactions from subjectively important audiences [83]. As adult students with dyslexia have often encountered negative school experiences which have affected self-esteem and damaged academic confidence, the self-presentation model may be a way of understanding some participants' anxiety around academic tasks involving evaluative situations.

Topham et al. have made a valuable contribution to the theory of social anxiety and the ways in which this interacts with and affects academic performance in their study [84]. They argue that social anxiety in learning is prevalent amongst young adult students and has a marked effect on their engagement with higher education. As Topham et al. have correctly identified, at University, interactive methods of learning are common and students are expected to interact with strangers, talk in groups and risk criticism of their work from peers and tutors [84]. To understand the phenomenon of social anxiety and the ways in which it interacts with learning at University, Topham et al. aimed to identify any possible change processes in student social anxiety using thematic analysis of qualitative responses to an online survey obtained from 39 year-two undergraduate students [84]. The survey was used to tap into student experience of learning situations, such as lectures, seminars, and group presentations. The results implied that there were four-stages of progression. The four stages were labelled: Stasis – participants' experiences of social anxiety had remained the same or intensified since attending University and their method of coping was largely through avoidance; Dialogue – participants' anxiety was still intense, but they had begun to make changes, or had awareness of what changes they needed to make; Engagement - students in this group were more engaged with their learning and had made efforts to manage their anxiety by for example,

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focusing on trying to answer questions which they knew the answers to during seminar discussions. Finally, the Autonomy group involved participants whose personal and academic lives were much less affected by anxiety. They felt more confident about managing it. Autonomy participants identified four factors that contributed to a reduction in their social anxiety: increased social familiarity; experience of University; understanding triggers for anxiety; increased self-acceptance [84, p.134].

V. Measures

As discussed above, general trait anxiety was measured using an adaptation of the questionnaire previously used in [1]. Items in the Carroll and Illes's questionnaire had been based on two established and copyright-free questionnaires: The Institute of Personality and Ability Testing (IPAT) self-analysis form [85]. This questionnaire consisted of 40 items divided into five subscales based on the author's extensive studies of the factorial structure of personality. The overall measure of anxiety shows good levels of internal consistency (Cronbach's alpha = 0.81) [86]. Evidence of the scales' validity are limited but it is reported in Psychological Reports to have high correlations with an objective test factor identified with anxiety [86], [87]. The second questionnaire that the Carroll and Illes questionnaire was based on was the Screen for Child Anxiety-Related Emotional Disorders (SCARED), [88]. This was a 38-item questionnaire to screen children for anxiety disorders. The authors of the SCARED initially administered this as an 85-item questionnaire to 341 outpatient children and adolescents and 300 parents. Utilising item analysis and factor analysis, the original scale was reduced to 38 items. A subsample of children (n = 88) and parents (n = 86) were retested an average of five weeks after the initial screening. The SCARED demonstrated good internal consistency (= 0.74 to 0.93) test-retest reliability (intraclass correlation coefficients = 0.70 to 0.90), discriminative validity (both between anxiety and other disorders and within anxiety disorders), and moderate parent-child agreement ($r = 0.20$ to 0.47, $p < 0.001$, all correlations). Carroll and Illes adapted these questionnaires and created items to measure general trait anxiety as existing questionnaires did not concentrate on the three separable areas of anxiety that they wished to investigate. Caroll and Illes's finalised questionnaire was measured as having an overall reliability of 0.878, while reliabilities for the individual subscales were as follows: 0.903 for academic anxiety; 0.870 for social anxiety; and 0.892 for appearance anxiety [1].

As this study's concern was specifically with academic and social anxiety, all items relating to appearance anxiety were deleted. This left a questionnaire comprised of 60 items with 30 questions each allocated to the two areas of anxiety – academic and social. Anxiety was assessed to determine whether students with dyslexia are specifically more anxious than students without dyslexia with regards to both academic and social situations. Overall, reliability for the anxiety scale was 0.939, while reliabilities for the individual subscales were as follows: 0.917 for academic anxiety; and 0.912 for social anxiety.

Each item on the questionnaire gave participants three options: *very like me; partly true;* and *not like me,* which were scored on a scale of 1-3, with 3 representing the highest levels of anxiety and 1 the lowest level.

VI. Sample

An ethics application form for the study was submitted to the research ethics committee at the author's home institution and ethical approval was granted. As the author is also a dyslexia practitioner, the sampling frame to obtain the dyslexic sample was derived from the researcher having access to a list of clients that attended ongoing study support sessions at a UK dyslexia consultancy between the period of 2011-2016 and who had a formal diagnosis of dyslexia. The survey once uploaded to Survey Monkey software was then emailed as a link to potential participant's email addresses. Additionally, considering clients that the consultancy supports are outsourced from a UK Russell Group University, University Disability Service staff agreed to email the survey link to all students registered with their service with a diagnosis of dyslexia only. It was specifically requested that only students with an official diagnosis of dyslexia should be forwarded the link. Further, students diagnosed with dyslexia and the comparison sample were recruited via a research advertisement posted by a University Communications Manager on the University's Twitter website. The advertisement provided a link to the survey. Table I shows the number of respondents from each gender and age category. Additionally, 24 people had opened the link to the survey, but had not fully completed the survey and these had to be nullified from the data.

TABLE I
Number of Participants Both Dyslexic and Non-Dyslexic Who Completed the Survey

	Dyslexic	Non-Dyslexic	Total
People who completed the survey	102	72	174
Females	75	57	132
Males	26	15	41
Aged between 18-24	49	48	97
Aged between 25-34	43	13	56
Aged between 35-44	4	5	9
Aged between 45-54	6	3	9
Aged between 55-64	0	2	2
Aged over 65+	0	1	1
People who had opened the survey, but had not fully completed it			24

VII. Results

In order to examine the differences between the dyslexic and non-dyslexic groups, individual *t* tests were carried out for academic anxiety and social anxiety using SPSS software. T tests were also carried out to examine differences between dyslexic and non-dyslexic females and dyslexic and non-dyslexic males on academic and social anxiety. Differences between dyslexic and non-dyslexic undergraduates and

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dyslexic and non-dyslexic postgraduates were also conducted using *t* tests for academic and social anxiety. Finally, to protect against inflated Type I errors when more than one *t* test has been performed on a single data set, the Bonferroni correction was used.

In agreement with the findings of [1], dyslexic students reported significantly higher rates of academic anxiety than the non-dyslexic students (dyslexic students N = 102 M = 65.8, SD = 9.7, non-dyslexic students N = 72 M = 57.0, SD = 10.9; t (172) = 5.59, p<.001, Cohen's d = 0.85) (see Fig. 2). However, dyslexic and non-dyslexic students, consistent with [44], reported very similar rates of social anxiety and there was no statistically significant difference (dyslexic students N = 102 M = 53.5, SD = 11, non-dyslexic students N = 72 M = 53.8, SD = 11.4; t (172) = 0.14, p>.05, Cohen's d = 0.02) (see Fig. 3).

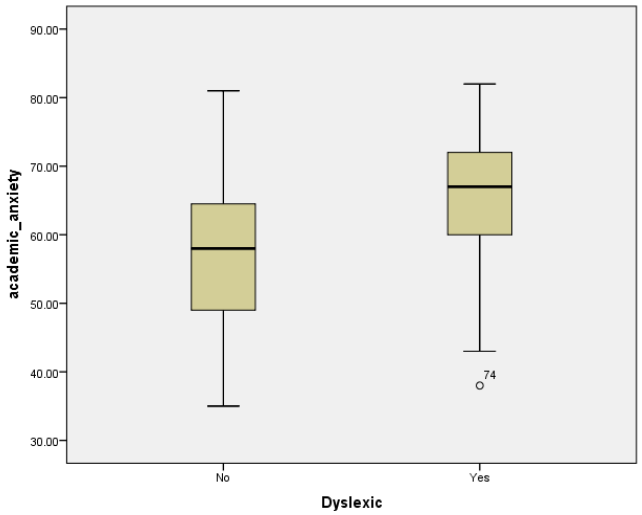


Fig. 2 T test results of academic anxiety between the dyslexic and non-dyslexic sample

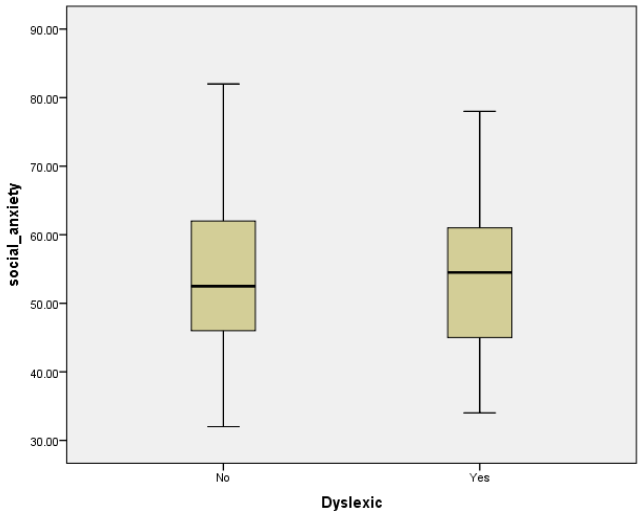


Fig. 3 T test results of social anxiety between the dyslexic and non-dyslexic sample

Analyses were also run separately by gender and by undergraduate/postgraduate status. Gender is frequently associated with anxiety, with women experiencing higher rates than men and therefore separate analysis by gender was warranted [89]. Carroll and Illes recruited [1] only undergraduates and therefore separate analysis by graduate status was warranted.

A. Gender

Female dyslexic students reported statistically significant higher rates of academic anxiety than the female non-dyslexic students (female dyslexic students N = 75 M = 66.7, SD = 9.3, female non-dyslexic students N = 57 M = 57.0, SD = 11.3; t (130) = -5.59, p < .001, Cohen's d = 0.94). Male dyslexic students reported significantly higher rates of academic anxiety than the male non-dyslexic students (dyslexic students N = 26 = M = 63.8, SD = 10, non-dyslexic students N = 15 = M = 57.0, SD = 9.3; t (39) = -5.59, p < .001, Cohen's d = 0.70). However, female dyslexic and female non-dyslexic students reported very similar rates of social anxiety and there was no statistically significant difference (dyslexic students N = 75 M = 53.3, SD = 11.5, non-dyslexic students N = 57 M = 53.8, SD = 12; t (130) = 0.14, p > .05, Cohen's d = 0.04). Male dyslexic and male non-dyslexic students also reported very similar rates of social anxiety and there was no statistically significant difference (dyslexic students N = 26 M = 54.3, SD = 9.8, non-dyslexic students N = 15 M = 53.9, SD = 9.2; t (39) = 0.15, p > .05. Cohen's d = 0.04).

B. Graduate Status

Undergraduate dyslexic students reported statistically significant higher rates of academic anxiety than the undergraduate non-dyslexic students (dyslexic students N = 68 M = 66.1, SD = 9.8, non-dyslexic students N = 42 M = 57.7, SD = 11.3; t (108) = 4.1, p < .001, Cohen's d = 0.80). However, undergraduate dyslexic students and undergraduate non-dyslexic students reported similar rates of social anxiety and there was no statistically significant difference (dyslexic students N = 68 M = 54, SD = 11.8, non-dyslexic students N = 42 M = 55.5. SD = 11.9; t (108) = -0.69, p > .05, Cohen's d = 0.12).

Postgraduate dyslexic students reported statistically significant higher rates of academic anxiety than the postgraduate non-dyslexic students (dyslexic students N = 34 M = 65.0, SD = 9.5, non-dyslexic students N = 30 M = 55.9, SD = 10.3; t (62) = 3.6, p < .001, Cohen's d = 0.92). However, postgraduate dyslexic and postgraduate non-dyslexic students reported very similar rates of social anxiety and there was no statistically significant difference (dyslexic students N = 34 M = 52.7, SD = 9.2, non-dyslexic students N = 30 M = 51.3, SD = 10.3; t (62) = 0.59, p > .05, Cohen's d = 0.14).

C. Statistically Significant Items from the Questionnaire

On 11 individual items from the 60-item questionnaire, dyslexic students scored significantly higher levels of academic anxiety than non-dyslexic students and these are presented in Table II.

TABLE II
STATISTICALLY SIGNIFCANT ITEMS FROM THE QUESTIONNAIRE

	Mann-Whitney U	P Value. Sig. (2-tailed)	Greater Levels of Anxiety for Each Item Indicated by the Higher or Lower Score	Mean Score for Non-Dyslexic Sample	Mean Score for Dyslexic Sample
I am confident and happy with my academic abilities.	2715	.001	Lower	96.8	74.2
I spend longer on my work than most people.	1959	.001	Higher	64	104
I feel a failure academically, in comparison to my peers.	2373	.001	Higher	69.4	100
I feel anxious when reading aloud in front of my class.	2117	.001	Higher	65.9	103
When about to enter an exam, I feel ill / shaky.	2331	.001	Higher	68.8	101
I feel overly anxious when I have exams.	2371	.001	Higher	69.4	100
I feel my literature skills may let me down in exams.	1430	.001	Higher	56.3	109
I am often brought to tears when I think about my academic abilities.	2586	.001	Higher	72.4	98
I get angry with myself for taking so long over one piece of work.	2409	.001	Higher	69.9	100
My work suffers if I am under pressure, and I work better if I have plenty of time.	2624	.001	Higher	72.9	98
I get frustrated when faced with a lot of reading.	2384	.001	Higher	69.9	100

All the items in Table II are related to academic anxiety and not social anxiety. Items "I feel a failure academically, in comparison to my peers", and "I feel anxious when reading aloud in front of my class" are consistent with findings of these items in [44]. To protect against inflated Type I errors when more than one *t* test is performed on a single data set, the Bonferroni correction has been used, which is a more stringent alpha level to judge statistical significance [90]. The adjusted alpha level is $p < 0.002$ (.05/30).

VIII. DISCUSSION

The purpose of this study was to confirm the prevalence of academic and social anxiety in a dyslexic compared to non-dyslexic sample with a quantitative survey, and secondly, to shape an understanding of the relationship between dyslexia and anxiety for the adult dyslexic learner in higher education. The hypothesis for this area of concern was:

Adult dyslexic learners in higher education have a higher prevalence of academic and social anxiety than their non-dyslexic peers.

Answers and new knowledge in relation to the above hypothesis were achieved and generated through, firstly, identifying the pervasiveness of academic anxiety levels in a large sample of dyslexic university students (N = 102) compared to a comparison group of non-dyslexic university students (N = 72). Thus, in response to the hypothesis, findings confirmed that dyslexic students are on average more anxious about academic matters than their non-dyslexic peers. This is consistent with results from the literature focusing on identifying the extent of comorbidities between dyslexia and internalising disorders in adulthood [1], [46], [47], [44]. However, unlike [1], yet consistent with [44], this study did not find a significant difference for levels of social anxiety between the dyslexic and non-dyslexic samples.

A possible explanation for the difference in the findings on social anxiety for this study compared to [1] could be differences associated with the younger age of the dyslexic sample used in [1] in comparison to the dyslexic sample used for this research [1]. Caroll and Illes's [1] dyslexic sample (N = 16) were all undergraduate students with ages ranging from 19 to 24 years, whereas of the 102 dyslexic students in this study, 34 were at postgraduate level and ages for the sample ranged from 18 to 64 years. This possible reason for the difference in the findings was tested with separate t tests for social anxiety for both the undergraduate and postgraduate groups and no significant difference was found between the dyslexic and non-dyslexic samples in relation to social anxiety for both the undergraduates and the postgraduates. Thus, the data do not support the theory that younger, lesser experienced dyslexic students will be more socially anxious than their non-dyslexic peers. This finding was also consistent with the Riddick et al. who also found no significant difference between the two groups in relation to social anxiety [44]. Relating this finding to Topham et al.'s theory of social anxiety and their identified four stages, a possible explanation could be that dyslexic participants in this study have an already established level of social familiarity, experience in academic situations, an understanding and metacognitive awareness of their anxiety triggers and a degree of self-acceptance [84]. The established level of social familiarity could be supported by the age differences of the dyslexic and non-dyslexic samples for this study. Out of the 102 dyslexic students, 49 were aged 18-24 years, yet 53 were aged 25+ years which implies they entered higher education at an older age. Whereas the non-dyslexic sample, out of the 72 students, 48 were aged 18-24 years and 24 were aged 25+ years. This younger age of the non-dyslexic sample could have had an effect on the results for social anxiety.

In relation to the state-trait model of anxiety, the expectation was that students would have higher levels of state anxiety (the experience of fear, nervousness, and discomfort instigated *temporarily* by situations perceived as dangerous), than trait anxiety (referring to a more stable tendency to

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experience fear, worry and anxiety across many situations). However, from the findings, although it was evident that academic events such as exams do indeed cause state anxiety for participants, the findings indicate that participants are experiencing more than just *temporary* state anxiety. Respondents reported anxiety and distressed emotion occurring across all academic situations, which is more suggestive of trait anxiety. For example, when looking at a few of the statistically significant items on the survey, such as: "I lack self-confidence in academic situations" p = .001; "I feel a failure academically in comparison to my peers" p = .001; and "I am often brought to tears when I think about my academic abilities" p = .001; it implies that negative emotional consequences, such as underlying feelings of anxiety are pervasive across many circumstances for participants. Thus, the anxiety is not confined to one individual situation for these participants and it is not always a *temporary* feeling of discomfort as suggested by the model of state anxiety. Instead it can be more demonstrative of trait anxiety with an underlying continuous stable tendency to experience worry and anxiety across many situations in academic environments.

Theories that do appear appropriate for helping to explain the findings of this research and to some extent help to provide an explanation for the relationship between academic performance and anxiety in the dyslexic sample in this study include Ohman's [61] information processing model of anxiety and Hadwin, Brogan and Stevenson's processing efficiency theory [76].

Ohman proposes that the significance of incoming stimuli, which, applied to an academic context, could be the prospect of a coming exam, or being asked to read aloud in class, becomes biased through emotion based on memory in the expectancy system [62]. Memory then has an influential effect over the stimuli and sends this information to the conscious perception system, which in turn evaluates whether the stimulus should be perceived as threat. Consequently, the findings indicated that in some situation's possible re-activation of memory of negative emotions, such as the fear of feeling stupid, ashamed, or embarrassed influenced the significance evaluators to perceive certain stimuli of information as threat. This was applicable in the way that some dyslexic students viewed certain learning situations such as item "I feel anxious when reading aloud in front of my class" and learning experiences "when about to enter an exam, I feel ill/shaky", which may be associated with the same learning situations that had made the student feel stupid during their younger lives.

Hadwin et al.'s processing efficiency theory, helps to explain how higher levels of anxiety impede academic performance, particularly on tasks requiring adequate working memory, which in a cyclical effect, increases anxiety levels further, which in turn has an even greater detrimental impact on tasks requiring working memory abilities [76]. Unlike the children used in Hadwin et al.'s study who only had high levels of anxiety and no known diagnosis of dyslexia, dyslexic students may have the comorbidity of high anxiety teamed with deficits in working memory, with negative consequences for their performance on tasks requiring efficient working memory, such as exams [76]. This theory helps to explain the statistically significant items from the survey of: "When about to enter an exam, I feel ill/shaky" p = .001; "I feel overly anxious when I have exams" p = .001; and "I feel my literature skills may let me down in exams" p =.001. Whilst traditional research on dyslexia has attributed poor academic performance to cognitive deficits associated with dyslexia [91]-[95], the evidence from the findings of this study suggests that poor performance, particularly in situations involving working memory, is exacerbated by the symbiotic interaction between anxiety, working memory and dyslexia.

IX. Conclusion

The research has extended and validated the results of Riddick et al. [44] and the Carroll and Illes's [1] studies through confirming, with a much larger sample size than previously used, that adult students with dyslexia do have higher levels of academic anxiety than their non-dyslexic peers. As such, the results of the study have shown that dyslexic students may be vulnerable to anxiety and stress in association with studying at university in general, and/or in connection with specific academic situations, such as exams. The study therefore indicates for the dyslexia practitioner, the importance, of not solely focusing on the development of cognitive strategies in supporting students with dyslexia. Although not all students with dyslexia will experience anxiety, it is still important for the dyslexia practitioner to understand an individual student's emotional difficulties in conjunction with their studies. The dyslexia tutor should work with the individual student on helping them to identify triggers and potential triggers for their anxiety and should be able to help the student to manage and to cope with the more negative emotional consequences of studying with dyslexia. Additionally, more emphasis on the emotional consequences of dyslexia needs to be implemented into training courses for dyslexia practitioners and educators.

There are several areas of future research which form natural extensions of this current work. Firstly, as identified in the literature review, the association of dyslexia and emotional difficulties has been researched in children and adolescents within school, yet, limited work has looked at how this develops and presents into adulthood. Therefore, there is currently a lack of longitudinal studies on dyslexic learners and their emotional and coping experiences from school into university, particularly from their perspectives. Secondly, as briefly mentioned in the limitations section, a replication of the study in a different educational setting would be useful. This would enable a comparison with this study to identify whether there is still a prevalence of anxiety in dyslexia compared to a non-dyslexic comparison group in a different education environment, and to establish the nature of coping in a different setting. Thirdly, the study intentionally gave emphasis to the perspectives of the dyslexic individuals that participated in the research. However, a future research project could perhaps shed light on different aspects of dyslexia and its association with anxiety, negative emotional consequences

and coping, which dyslexic individuals might have overlooked, by including the viewpoints of other people involved in the personal and scholarly lives of the dyslexic individual, such as parents, spouses, family members, friends, dyslexia practitioners, and mental health advisers. This type of further study could perhaps add an additional layer of understanding to our knowledge on dyslexia, anxiety and coping.

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