ACADEMIC CONFIDENCE AND DYSLEXIA AT UNIVERSITY

Andrew Dykes B.Ed., M.A., M.Sc., CELTA, FHEA

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School of Health and Education

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This thesis is an account of the study, research processes, data analysis and discussion of an attempt to understand more about how the academic confidence of university students with dyslexia in the UK is affected by the identification of their dyslexia.

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ABSTRACT

This study explored how university students' academic confidence may be affected by them being identified as dyslexic. Contemporary views of dyslexia range from considering it primarily as a literacy-based, specific learning difficulty (BDA, 2017), to a multi-factorial information processing difference (Tamboer et.al., 2016). Currently, and by defining dyslexia as a disability, dyslexia-identified students at university in the UK are entitled to receive academic support to enable equitable engagement with their studies.

Confidence is a robust dimensional characteristic of individual differences (Stankov, 2012) and academic confidence has been defined as the level of strong belief, firm trust, or sure expectation of responses to the demands of studying at university (Sander & Sanders, 2006a). Academic confidence has been linked to academic capability and ultimately, to academic achievement (de la Fuente et.al., 2013). In this study, academic confidence was gauged using the Academic Behavioural Confidence (ABC) Scale, a metric designed to explore and explain differences in the study behaviours and learning strategies of students at university (Sander and Sanders, 2003, 2006a, 2009). The ABC Scale draws from the Social Cognitive Theory (SCT) of Bandura, and particularly the application of SCT to learning through the concept of self-efficacy (Bandura, 1997), considered as the parent construct of academic confidence (op cit, 2006a).

Data was collected by self-report questionnaire from a sample of n=166 university students, who had declared either a dyslexic learning difference or not. By comparing differences in ABC between students with dyslexia and those with no identified dyslexia, evidence emerged that the non-dyslexic students showed significantly higher levels of academic confidence than their dyslexia-identified peers, principally indicated by a moderate-to-large effect size range ($0.532 < g < 1.086$). From the non-dyslexic group, a sub-group of quasi-dyslexic students was identified, being those who presented attributes and characteristics that were similar to those in the dyslexic group. To achieve this, a fresh metric was developed, the Dyslexia Index (Dx) Profiler, which framed dyslexia through the lens of study skills and learning behaviours at university. Existing dyslexia screeners were considered to be ethically inappropriate for this study. The academic confidence of students in the quasi-dyslexic group was compared to those in the dyslexic group, and the remainder of the non-dyslexic group. The quasi-dyslexic students also had substantially higher levels of academic confidence in comparison to their dyslexia-identified peers, indicated by a small-to-moderate effect

size range ($0.184 < g < 0.406$). For students in the dyslexic group, significant differences in ABC were also revealed as a function of how these students were told of their dyslexia, with those whose dyslexia had been diagnosed as a disability showing the lowest levels of ABC. To further explore more nuanced differences between the groups, both principal component analysis and a tentative regression analysis were used.

The main conclusion drawn from the analysis outcomes was to suggest that identifying dyslexia in university students may be counter-productive, because this might negatively impact on academic confidence, and possibly on academic achievement.

LIST OF ABBREVIATIONS

Abbreviation	Explanation
ABC	Academic Behavioural Confidence
ACS	Academic Confidence Scale
ADD	Attention Deficit Disorder
ADHD	Attention Deficit Hyperactive Disorder
ADSHE	Association of Dyslexia Specialists in Higher Education
BDA	British Dyslexia Association
BRAIN.HE	Best Resources for Achievement and Intervention re Neurodiversity in Higher Education
CDT	Cerebellar Deficit Theory
DAST	Dyslexia Adult Screening Test
DSA	Disabled Students' Allowance
Dx	Dyslexia Index
EMCS	Eigenvalue Monte Carlo Simulation
HE	Higher Education
HESA	Higher Education Statistics Agency
IPA	Interpretative Phenomenological Analysis
LADS	Lucid Adult Dyslexia Screener
MSc	Master of Science
MIS	Meares-Irlen Syndrome
NHST	Null Hypothesis Significance Testing
PCA	Principal Component Analysis
QAA	Quality Assurance Agency for Higher Education
QRI	Questionnaire Response Identifier
RG:DI	Research Group DI - students with identified dyslexia
RG:DNI	Research Group DNI - students with quasi-dyslexia
RG:ND	Research Group ND - students with no identified dyslexia
SATA	Scholastic Abilities Test for Adults

SCT	Social Cognitive Theory
SLE	Smart Learning Environment
STM	Short Term Memory
SSD	Speech Sound Disorder
TEF	Teaching Excellence Framework
UDL	Universal Design for Learning
ViS	Visual Stress
VLE	Virtual Learning Environment
WFN	World Federation of Neurology
YAA-R	York Adult Assessment - Revised

1 STUDY OVERVIEW

1.1 ACADEMIC CONFIDENCE AND DYSLEXIA AT UNIVERSITY

This study explored how the academic confidence of students at university may be affected by dyslexia-ness, the term used throughout this thesis to describe an individual's intensity of dyslexic characteristics or dimensions.

The research was about gauging how the dyslexia-ness of students with identified dyslexia, or with previously unidentified dyslexia-like profiles (termed *quasi*-dyslexia), may impact on their study strategies and processes in relation to their sense of academic purpose. This was achieved by exploring the confidence they express in meeting the academic challenges of university. Thus, the objective was to determine whether an association exists between levels of dyslexia-ness and levels of academic confidence. The academic confidence of students with few or no indications of dyslexia will be used for comparison.

I DYSLEXIA

In the context of this project, dyslexia at university is viewed as a learning difference rather than a disability. It is acknowledged however, that at its core, a legacy of literacy challenges in earlier schooling may place additional study demands on some university students with dyslexia in comparison with their non-dyslexic peers, which may place them at a learning disadvantage, and which might be viewed as disabling. However, defining dyslexia remains contentious (e.g.: Tunmer & Greaney, 2010; Elliott & Grigorenko, 2014; Nicholson & Fawcett, 2017) especially in adults. This is perhaps unsurprising given the predominance of literature in the field has been interested in the syndrome in children, with a shift in focus to dyslexia in adults being relatively recent. This in part acknowledges that dyslexia persists into adulthood (Undheim, 2009; Carawan et.al., 2016), but also that since many higher intellectual functioning dyslexic adults are now attending university (Tops, et.al., 2012; Pino & Mortari, 2014), the arguably disparate nature of dyslexia has become more evidenced, not least by exploring levels of support for students with dyslexia and its effectiveness (Dobson, 2019).

The most wide-ranging and locally (i.e. UK) pertinent statement to describe dyslexia is demonstrated by the set of characteristics offered by the British Dyslexia Association (BDA, 2018). These suggest that: dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling, and occurs across the range of intellectual abilities; that characteristic features are difficulties in phonological awareness, verbal memory, verbal processing speeds, and that co-occurring challenges may be apparent in aspects of language, motor co-ordination, mental calculation, concentration and personal organization. Notably, the BDA indicates that dyslexia can be best considered as a continuum (Jamieson & Morgan, 2008; Reid, 2016, 2019; Edwards et.al., 2018, Spanoudis, 2019;) with no clear boundaries rather than a distinct category, not least due to the diverse range of characteristics that may be present or not in dyslexic individuals.

This current study acknowledges the breadth of this 'definition' of dyslexia and contends that it can be seen to be aligned with the more recent approaches towards understanding dyslexia as a multifactorial condition (Tamboer et al, 2014; Tamboer et al., 2017), which is arguably more relatable to the specific subset of adults with dyslexia who attend higher education. This is the

contemporary view that the syndrome impacts on a range of literacy, cognitive and organizational competencies which, through variances of both degree and co-morbidity, can render the dyslexic individual at a disadvantage in conventionally delivered, literacy-based learning environments. The dyslexia debate is discussed more comprehensively in Section 2.1, where a selection of literature pertaining to the nature and aetiology of dyslexia is discussed, and where the stance of this current study on dyslexia is elaborated.

However, by taking the multifactorial approach to dyslexia, and so that the study could draw on a research pool of students across the complete university community, it was necessary to develop an innovative profiler to gauge dyslexia-ness. This was one which did not focus on deficit-discrepancy models or on disability, and which avoided ethical issues of disclosure that would have arisen had an existing dyslexia screener been used with non-, and especially with quasi-dyslexic students. This profiler was built from dimensions of dyslexia that have been shown to be typical amongst university students with dyslexia, but which could also be relatable study behaviours of non-dyslexic students. The development of this profiler is discussed in Section 3.6.

II ACADEMIC CONFIDENCE

Academic confidence is set as the dependent variable in this study. The position will be adopted that academic confidence is a sub-construct of academic self-efficacy (Sander & Sanders, 2003), and is concerned with a student's belief about their capability to perform a task at a particular level to attain a specific goal. Along with self-esteem, self-confidence, and notably, self-efficacy, these beliefs and attitudes form the core of our self-concept (Pajares & Schunk, 2005), and at university, act to guide students through the academic challenges that university study presents (Sander & Sanders, 2006a).

Academic confidence is grounded in the self-efficacy component of Social Cognitive Theory (SCT) (Bandura, e.g.: 1977, 1986, 1997a), itself concerned with how human actions and behaviours are self-regulated. Increasingly, components of the self, and more particularly, self-beliefs, are being cited as key indicators of students' motivation in learning environments (Zimmerman, 2000; Pajares & Schunk, 2002; McGeown, et. al., 2014). Academic confidence is likely to emerge primarily as a result of mastery experiences (Skaalvik & Skaalvik, 2002, Usher & Pajares, 2006), this being one of the four components of SCT, and is about achievements built on positive prior experiences in related, relevant contexts. The others are vicarious experiences - formed largely through gaining a sense of capability in comparison with others engaged in the same undertaking; verbal persuasion, notably through encouragement by people significant to the individual; and physiological and affective states, that is, how we *feel* when we are engaged in an activity or endeavour. These components of SCT are elaborated in Section 2.2/II.

Academic self-efficacy focuses on the features of self-efficacy which are presented in learning contexts. The research contributions of Zimmerman, Schunk and Pajares have been selected to demonstrate how SCT can be applied in educational settings, not least due to their relevance to university contexts. In particular, Zimmerman placed academic self-efficacy as a central component of the learning process through learners' beliefs in their capabilities to self-regulate their learning and master academic challenges, acquire new ideas and communicate their knowledge. Zimmerman (1990) evidenced that students who are competent self-regulators achieve stronger

academic outcomes than their otherwise comparable peers who are poor self-regulators. All of these concepts and constructs are discussed in Section 2.2/III.

III ACADEMIC BEHAVIOURAL CONFIDENCE

Academic behavioural confidence is used to operationalize academic confidence through use of the Academic Behavioural Confidence (ABC) Scale, following precedents set in other studies (e.g.: Putwain et al., 2013; Nicholson, et.al., 2013). ABC emerged from earlier attempts to explain differences in the reasons provided by university students from two different cohorts to defend their preferences for particular pedagogical processes, namely learning through role-play or through peer-group presentations. At that time, academic confidence was proposed as “a mediating variable between the individual's inherent abilities, their learning styles and the opportunities afforded by the academic environment of higher education” (Sander & Sanders, 2003, p4). It was first operationalized as the Academic Confidence Scale which was later revised into the Academic Behavioural Confidence Scale because it was better seen to be gauging confidence in behaviours, actions and plans related to academic study (Sander & Sanders, 2006a). The ABC Scale is designed to be a general measure of students' confidence about their academic work at university.

IV LOCATION AND STANCE OF THE STUDY: IMPACT STATEMENT

This study provides evidence to suggest that students who know about their dyslexia present lower levels of academic confidence in comparison with their non-dyslexic peers. The study also shows that the terminology used to tell newly-assessed students of their dyslexia may also have a significant effect on their academic confidence. This adds to the limited range of research relating to the academic confidence of university students from minority groups, especially those deemed to have learning disabilities however these might be defined. The conclusions of the study support a contemporary view favouring a shift in the delivery of university learning towards increased inclusivity and accessibility. The impact of this would be that be accommodating greater learner adaptability and learning flexibility, learners with dyslexia, however this is also defined, might feel more included and less 'different' (e.g.: Dykes, 2008; Thompson et al., 2015).

This might be achieved by adopting the principles of Universal Design for Learning (UDL; Rose et al., 1999; Rose & Meyer, 2002), an original approach to redesigning classrooms and curriculum delivery to extend the rights of students with disabilities for better access to the general education curriculum. Encouraging the design and development of more accessible curricula is argued to be preferable to retrofitting the curriculum to the learner (Lancaster, 2008) by way of 'reasonable adjustments' (discussed in sub-section 2.1(I)). UDL provides a blueprint for institutions to become accessible and inclusive without the need for differentiation of learning spaces or curriculum delivery, previously thought as the most appropriate way to accommodate the atypical learning needs of disabled students. In UDL environments the principles of inclusivity are embraced, thus ameliorating an emerging disconnect between the 'one-size-fits-all' curriculum and increasingly more diverse communities of learners (Edyburn, 2010).

Thus, it is reasonable to suppose that the positive strengths and qualities that form part of a spectrum of apparent learning differences could be integrated into the development of the learner in ways that would encourage a greater sense of academic agency to emerge through stronger academic confidence. Hence, this may contribute positively towards better and more successful academic outcomes at university (Nicholson et al., 2013). Zimmerman spoke of academic confidence in the context of academic agency (discussed in Section 2.2(III)), which he described as "a sense of [academic] purpose, this being a product of self-efficacy and academic confidence that is then the major influence on academic accomplishment" (1995, p202). It is through the lens of academic confidence, as a sub-construct of academic self-efficacy (Sander & Sanders, 2006a), that this research project has been tackled.

Hence, the stance of the research particularly supports those aspects of the inclusion agenda in education contexts which advocate rethinking the design and delivery of learning curricula, not least to reduce the persistent reliance on literacy-based formats, claiming that this is inherently unjust. This is to argue for the re-framing of learning and teaching environments at university to accommodate learning diversity more equitably, which may then consign into redundancy the need for special conditions and reasonable adjustments for many students with unseen differences or disabilities.

1.2 Research Design and Methodological Overview

I Background - the preceding small-scale enquiry

The legacy of outcomes from the researcher's preceding MSc. dissertation (Dykes, 2008) has had a significant impact on the development of this current project. This was a small-scale enquiry conducted within the dyslexic student community at a UK university. The aim was to try to understand why some students with dyslexia strongly advocated the learning support value of a dedicated learning technology suite staffed by dyslexia and disability specialists; whilst others with apparently similar dyslexic profiles appeared ambivalent towards these services. This was evidenced through the former making frequent use of the suite and services whereas the others were only infrequent visitors despite initially registering for access. It was hypothesized that this disparity might, in part at least, be due to differences in the attitudes and feelings of students with dyslexia to their own dyslexia, but particularly to their perceptions about how it impacted on their access to, and their engagement with their learning at university.

The analysis outcomes were mixed, making it difficult to establish clear conclusions and revealing that the issue was far from straightforward; but also could have been attributable to the small sample sizes of the research groups and to a research design which, with hindsight, could have been better developed. However, three influential aspects emerged from this study: firstly, lessons were learned about constructing online survey questionnaires and in particular how to design and incorporate Likert-style scale items into questionnaire design; secondly, considerable value was ascribed to the development of profiling charts to visualize quite complex interrelationships between variables (see Section 3.3/III.2). An important aspect of these were the opportunities they

afforded to spot patterns, similarities and contrasts, not so much between the profiles of individual respondents, but how respondents could be grouped into subsets. Thirdly, it became clear that the opportunity provided in the questionnaire for students to reflect and report on how they felt their dyslexia impacted on their studies, and how the university responded to their learning needs, was widely welcomed. This qualitative data was optionally provided, although a significant majority of participants contributed to this section of the questionnaire.

II STRUCTURE AND PROCESS

1. EPISTEMOLOGICAL POSITION

This was a primary research project grounded in a methodologically pluralistic approach (Johnson & Onwuegbuzie, 2004; Johnson et.al., 2007). Thus, a blend of both quantitative and qualitative methods and analysis was used, an approach widely practised across domains of educational research (Seigel, 2006). The epistemological position draws from four components of sources of knowledge: intuitive: concerning belief, faith, feelings; authoritarian: from taught, defined or existing facts; logical: as deduced from reasoning; and empirical: being demonstrated from experimentally derived evidence. However, a greater reliance is placed on the logical and objective interpretation of facts established from observed data. Hence this is to adopt a Deweyist pragmatic philosophical position grounded in pluralistic empricism in relation to the design and action of the research process and for understanding the outcomes (e.g.: Shook, 2002). Espousing the positivist paradigm generally attributed to Comte (Acton, 1951; Cohen, et.al., 2007), the purpose of the research was to accept or reject hypotheses through due scientific process. In this way, statistical analysis of data leading to generalizable findings based on comparisons between a control and an experimental (or test) group were the basis.

2. PROCESS

This study has been underpinned firstly by a review of a range of literature (in Section 2.1) on the nature, aetiology, identification and assessment of dyslexia, with dyslexia amongst university students framing the selection strategy. This informed the establishment of a fresh descriptor, dyslexia-ness, as one element of the research design. Being a measure of the intensity that the attributes and characteristics of dyslexia have on study behaviours at university, dyslexia-ness is built on the understanding that dyslexia is best considered as a continuum construct rather than a categorical one. Stemming from the broad, BDA definition of dyslexia, this led to the idea of The Dyslexia-ness Continuum (see sub-section 3.3.III/2(2.2)) where dyslexia-ness has been operationalized through the development of a profiler and a new metric, Dyslexia Index (Dx), which aimed to be valid across the wider student community rather than be focused specifically at students with identified dyslexia. This served as an essential component to the study, enabling a test sub-group of quasi-dyslexic students to be established in a way that was ethically non-controversial. These were students who appeared to be presenting many characteristics and attributes typically associated with dyslexia but who were not identified as dyslexic. Thus, comparisons could be made with both a control subgroup of students with a formal identification of dyslexia, and a base subgroup of non-dyslexic students, as determined by their low levels of dyslexia-ness in the profiler.

Secondly, a comprehensive review of the theory and previous research relating to academic confidence, principally operationalized through academic *behavioural* confidence, has been presented (in Section 2.2). Academic confidence is located within the framework of the parent construct of academic self-efficacy, itself identified as an element of Social Cognitive Theory (SCT) in extensive earlier research by Bandura (e.g.: 1997b, 2000, 2001). SCT about explaining human behaviour in the context of systems of self-regulation, and Bandura's thesis is that these systems are the principal activators of all individuals' actions and behaviours. The theory is outlined and selectively reviewed, particularly in relation to education and learning in Section 2. Hence, the use of academic confidence as a construct is discussed from the theoretical perspective, with data collected using the existing, Academic Behavioural Confidence (ABC) Scale, which sets out to gauge students' actions and behaviours in academic study (Sander & Sanders, 2006a).

Data collected from a sample of university students through an online, self-report questionnaire was largely quantitative, although additional qualitative responses were invited. Statistical analysis set out to explore research questions about the extent to which dyslexia-ness impacted on academic confidence (see 1.4, below). Null hypotheses are stated, and evidence to address these was based on effect size differences between research group and subgroup sample means, supported by conventional independent sample means' *p*-value outcomes. Although the analysis was able to respond adequately to the research hypotheses, it was considered that exploring dimension reduction techniques using principal component analysis might add depth to the results. The outcomes were mixed, perhaps indicating that this approach may need a larger and/or more diverse sample for more convincing outputs to be generated. A regression analysis was also tentatively explored to determine whether the output might add substance to the analysis outcomes (see Section 4). These additional analyses are reported and discussed, although the results are used mainly to suggest possible directions for future research (see Section 6).

Qualitative data was also collected, although providing it was optional, with none being received from students in the non-dyslexic group. Hence, although conducting an Interpretative Phenomenological Analysis may have been a possible approach for analysing these data for the dyslexic group alone, as no comparison was available with other participants, it was considered more appropriate to use these data to contextualize some of the statistical conclusions in the discussion element of the thesis instead, and where apposite (see Section 5). However, these data have been reserved for a focused analysis later which may be included in a subsequent study.

III REGISTER

The majority of this thesis is written objectively and in the third person. However, some sections relate more of the personal and reflective elements of the learning journey of the researcher, and hence are narrated in the first person. This also serves to distinguish between the reporting of the evidence-based outcomes of the project and my stance as a practitioner-researcher in the field of education and learning development at university. Where direct quotations have been taken from other literature, these are shown in double quotation marks; single inverted commas are used as marks of emphasis (e.g.: 'reasonable adjustments'); direct quotations from participants in this, and other studies are italicized when presented in the narrative, or shown in a reduced font-size when part of a bulleted list.

1.3 Research Importance

No peer-reviewed studies were found that specifically explore how the academic confidence of dyslexic students at university may be affected by their dyslexia when compared to their *quasi*-dyslexic and non-dyslexic peers. Searching across journals databases revealed only an unpublished dissertation (Asquith, 2008) which explored how dyslexia was related to academic confidence and to self-esteem. This study hypothesized that dyslexic students who were receiving support would present higher levels of each of these constructs in comparison to dyslexic students who were not. A significant feature of the study was an assumption that a proportion of the apparently non-dyslexic students recruited into the study may present characteristics of dyslexia, as determined by use of the Vinegrad Adult Dyslexia Checklist (Vinegrad, 1994). Hence, three research subgroups were established: dyslexic students, non-dyslexic students and quasi-dyslexic students although this term was not used. Although not considered as a precedent, similarities between that study and this current research were apparent. Discussed more fully later (Section 2.2), briefly, Asquith identified significant differences in mean values of academic confidence, (evaluated using the ABC Scale), between dyslexic and non-dyslexic students. Investigating differences between dyslexic and quasi-dyslexic, or non-dyslexic versus quasi-dyslexic students did not appear to have been attempted. Nothing was said about how ethical tensions were resolved in relation to apparently identifying dyslexic students previously considered to be non-dyslexic, and how this may have been disclosed and followed up. However, although limited in its scope, research design, and verifiable outcomes, Asquith's study has been a useful example of one of the earliest uses of the ABC Scale, notably with dyslexic students. This current study takes a more robust approach to developing clearly focused research questions (see 1.4, below), addressed by a research design (Section 3) grounded in an extensive review of the pertinent literature (Section 2), together with a more elaborate analysis of data collected (Section 4). Hence this study fills a gap in the existing research.

1.4 Research Questions and Hypotheses

Research questions were formulated thus:

Firstly, do students who know about their dyslexia present different levels of academic confidence to that of their non-dyslexic peers? If so, can factors in their dyslexia be identified as those most likely to account for these differences, and are these factors absent or less-significantly impacting in non-dyslexic students?

Secondly, do students with no formally identified dyslexia, but who show evidence of a dyslexia-like learning and study profile, that is, present quasi-dyslexia, present different levels of academic confidence to that of their dyslexia-identified peers? If so, are the outcomes sufficient to suggest that identifying dyslexia in student learners is detrimental to their academic confidence?

Hence these research questions enabled two, corresponding hypotheses to be formulated:

- $H_o(1)$ = There is no difference between dyslexic and non-dyslexic students' levels of academic confidence;
- AH(1) = Non-dyslexic students present a higher level of academic confidence than their dyslexic peers.

- $H_o(2)$ = There is no difference between dyslexic and quasi-dyslexic students' levels of academic confidence;
- AH(2) = quasi-dyslexic students present a higher level of academic confidence than their dyslexic peers.

Furthermore, amongst students with identified dyslexia, does the manner in which these students have learned of their dyslexia impact on their levels of academic confidence? Is there evidence more specifically, that students whose dyslexia has been *diagnosed* to them as a *disability* present lower levels of academic confidence than those whose dyslexia has been reported to them in other ways, for example, *identified* as a *difference.* 'Diagnosis' is principally a medical construct used to determine the existence of an illness, including mental illness, or a physiological or health abnormality, and affective responses to being 'diagnosed' are widely reported in a variety of fields. In the context of dyslexia, if lower levels of academic confidence are found to be associated with a diagnosis of dyslexia as a disability, this may suggest that the importance of *not* presenting dyslexia as a clinical or medical condition, implied by diagnosing it, could be more widely understood. Given the aspiration of higher education to be inclusive and non-judgmental, not least through the widespread adoption of the social model of disability, it might be argued that diagnosing dyslexia as a disability is evidence of an albeit tacit, but nevertheless embedded legacy of the out-dated, medical model of disability.

Hence these subsidiary questions prompted a further hypothesis:

- $H_o(3)$ = Amongst students with dyslexia, there is no difference in academic confidence between students whose dyslexia was formally diagnosed to them as a disability, and those who formally learned of their dyslexia in other ways;
- AH(3) = Students who were formally diagnosed with dyslexia as a disability present lower levels of academic confidence than their dyslexic peers who formally learned of their dyslexia in other ways.

2 THEORETICAL PERSPECTIVES

A REVIEW OF SELECTED LITERATURE

INTRODUCTION

This thesis is exploring how dyslexia affects academic confidence in university students. Academic self-efficacy and academic confidence stem from the same components of self-efficacy (Sander & Sanders, 2006) proposed by Bandura as core to Social Cognitive Theory (SCT), (Bandura, 1977. 1986, 1997a) which is discussed in some detail. Applying this underpinning theory to university contexts, Sander and Sanders (2003) suggest that academic confidence is thus likely to be a mediating variable that acts between a student's inherent academic capabilities, their learning-style preferences and the opportunities for gaining creditable academic achievements that exist at university as experiences impact on expectations. To gauge academic confidence, the Academic Behavioural Confidence (ABC) Scale was developed as a means to assess students' levels of confidence in their behaviours, actions and plans in tackling their academic study (Sander & Sanders, 2007). The ABC Scale is the metric used in this study with the aim of looking for significant differences in ABC between dyslexic and non-dyslexic students.

However, this section of the thesis opens by reviewing a selection of literature that is germane to the nature of dyslexia. The review is not an exhaustive discussion about how dyslexia has come to be understood through more than a century of research and theorizing, as this is too large a task for this thesis. Instead, it will try to navigate a path through competing theories to highlight some of the tensions, conflicts and contradictions between aetiologies that continue to make research about dyslexia challenging. It will focus on aspects of these which especially impinge on this project and will align the discussion in support of the view that early, definitional paradoxes can now be set aside, in university contexts at least, not least because the most significant of more recent constructions of dyslexia may be challenging whether it makes any sense to be diagnosed as 'dyslexic' at all. These firstly advocate that dyslexia should be best considered as a multifactorial set of characteristics or dimensions, which, although drawing on earlier constructions of dyslexia (e.g.: Castles & Coltheart, 1993), has now attracted significant research interest in the HE sector (e.g.: Tamboer et al., 2016, Tamboer et al., 2017). This approach to understanding dyslexia is to consider its impact on a student's academic progress in a variety of both positive and less helpful ways: for example, it is suggested that innovative and creative thinking may be heightened in students with dyslexia (e.g.: Everatt et al., 1999; Chakravarty, 2009) which might be thought advantageous in some disciplines such as in the Arts, architecture or engineering. In contrast, the frequent use of highly specific and precise terminology in mathematics for example, has been shown to cause difficulties to dyslexic students where similar sounding words – such as ‘integer’ and ‘integral’ - have very different meanings (Perkin & Croft, 2007). Secondly, it has been suggested that more recent thinking about the nature of dyslexia might direct educationalists and especially teaching practitioners towards accepting dyslexia as a wide-ranging set of learning attributes that are positioned along a spectrum of entirely natural, human neurodiversity (Cooper, 2006) but which also acknowledges the atypical nature of this blend of attributes. Although tackling the nature of dyslexia from a different perspective, the neurodiversity approach does allude to multifactorialism as a process for understanding more about what it means to be dyslexic. Hence it can be argued that in order to accommodate both the wider neurodiversity agenda and specifically the multifactorial construction of dyslexia, the focus in learning and teaching environments now needs to shift towards adjusting them in ways that are properly inclusive, accessible and flexible rather than continue to put the dyslexic individual at the centre of the 'reasonable adjustments'

agenda because that may reinforce the internalizing of dyslexia as a disabling condition. Hence it is reasonable to assume that a greater accommodation of learning-and-teaching diversity should ameliorate much of the stigma associated with feelings of being different or disabled in learning contexts (Dykes, 2008; Shaw & Anderson, 2018). Lastly, much of the recent literature supports the suggestion that a more useful framework for understanding dyslexia might now exist by considering it as alternative form of information processing (Tamboer et al., 2014) which disassociates dyslexia from disability and difference almost completely. The closing narrative of the first sub-section briefly discusses how dyslexia is assessed or identified in HE contexts and prequels the major part of the study's research design where a new process for gauging dyslexia in university students has been developed as the independent variable in this study which aims to locate the dyslexic individual's learning attributes on a continuum of study and learning dimensions that are observable in any student, either identified as dyslexic or not.

2.1 DYSLEXIA

I DYSLEXIA, WHATEVER IT IS, IS COMPLICATED.

The contemporary view of dyslexia as it occurs in university students is to consider it as a learning difference rather than a learning disability, although the syndrome remains widely debated (Elliott & Grigorenko, 2014). Attempts to theorize developmental dyslexia and its aetiology differ quite widely (Peterson & Pennington, 2015), not least when attempting to interpret the variety of characteristics that can be presented (Ramus, 2004, Proctor et al., 2017). This is especially so in relation to how cognitive differences, more usually regarded as deficits, are classified as dysfunctions (Buttner & Hasselhorn, 2011) and whether these differences are causal, consequential or even covariates of dyslexia as a learning disability (Vellutino et al., 2004). The impacts of dyslexia and dyslexia-like profiles on learning are readily apparent in literacy-based education systems, ranging from initial identification in early-age learners who experience challenges in the acquisition of reading skills, to university students who attribute many of their struggles to adapt to the independent and self-managed learning processes that are core competencies in HE learning to a dyslexia or dyslexia-like learning profile (MacCullagh et al., 2016).

In the last half-century, attempts to define dyslexia to account for this range of traits have moved away from earlier definitions which focused on dyslexia as a reading impairment in children, more specifically a difficulty in single-word reading fluency and spelling. For example Critchley (1970) provided a brief summary of the historical origins of identifying and attempting to define dyslexia, pointing out that the challenges in arriving at a convincing definition of dyslexia had led some authorities to abandon attempts to do so. Although it is not known which authorities were being referred to, it is reasonable to consider that the reason for this casting-aside could have been due to the plethora of competing definitions of dyslexia that were available to choose between. Drawing on the most recent definition at that time from the World Federation of Neurology (WFN), Critchley supported his point by quoting two, parallel definitions which were recommended for acceptance by neurologists, paediatricians, psychologists and those practicing in the pedagogic domains who perhaps chose the definition that most suited their purposes at the time:

- Specific developmental dyslexia:
  - "A disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportunity. It is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin"
- Dyslexia
  - "A disorder in children who, despite conventional classroom experience, fail to attain the language skills of reading, writing and spelling commensurate with their intellectual abilities" (ibid, p11).

It was later suggested that the WFN definitions were inadequate without further defining some of the constituent terms, such as explaining what should be understood as 'conventional instruction' or 'intellectual abilities' for example (Snowling 2002). It was further argued that definitions were weak to the extent that practitioners attempting to use them to determine whether a child was presenting dyslexia or not, were likely to find this a challenge (ibid). Snowling's reasoning about phonemics being now better comprehended, were thought to be instrumental in understanding dyslexia in children more comprehensively. Phonemics is taken as the study of the sound system of a language and the classification of its phonemes (sound parts). Significant amongst studies

drawn upon was a project conducted to explore and explain differences between children who, as poor readers, responded to interventions and remediation, and others of similar intellectual abilities who did not (Vellutino et al., 1996). Amongst the research outcomes of this study were the identification of other apparent deficits which appeared to result from phonological skills differences between 'regular' poor readers and dyslexic children. These were reported as poorer short-term memory performance and rapid-naming deficits, but especially, depressed phonological awareness. This is the ability to recognize how words are comprised of connected sound structures, the ability to distinguish the syllables of a word and particularly to tune in to the individual sounds, or phonemes, of a word. This will be discussed a little more in sub-section 2.1(II) below. Beyond emphasizing the importance of acknowledging phonological processing difficulties as significant in understanding what dyslexia is, Snowling's (2002) discussion proposed that dyslexia should be thought of as more than an issue with literacy. This is demonstrated not least by stating that “dyslexia is [likely to be] characterized by a particular cognitive profile that places a child at risk of reading failure” (ibid, p20), which additionally alludes to the usefulness of profiling in comprehending more about a range of deficits, differences or dimensions which are likely to exist on a continuum as opposed to being discrete categories, a likely development of a similar suggestion proposed some time earlier (e.g.: Ellis, 1985). Much later work by Callens et al. (2012) took cognitive profiling into HE contexts and also into a language other than English through a study of Dutch students, discussed in more detail below (sub-section 2.1(II)). In the Research Design section (3), embracing the dimensionality aspect of dyslexia will be demonstrated in the justifications for designing the Dx Profiler as a tool determining levels of ‘dyslexia-ness’.

It was considered important to bring the definition discussion into the contemporary context of dyslexia amongst university students, and to this end, a straw poll enquiry was conducted as part of the foundations of this current study (see sub-section 3.I(IV) and Appendix 8.1(I)). The outcomes established not unsurprisingly that the definition of dyslexia proposed as workable and understandable by the British Dyslexia Association (BDA) has tended to be the one that has been broadly adopted in HE institutions in the UK over the last decade. This is a definition which acknowledges much of the preceding research evidence, but which also takes a more inclusive approach by making no specific mention of deficits, and affirms that some of the traits of dyslexia should be recognized as abilities rather than as disabling:

- "Dyslexia is a combination of abilities and difficulties that affect the learning process in one or more of reading, spelling or writing and may have accompanying weaknesses in processing speed, short-term memory, organization and sequencing" (BDA, 2007).

This definition has since been updated, with the most recent version (BDA, 2018) enshrining the findings of a report commissioned by the UK Government's Department for Children, Schools and Families about identifying and teaching people with dyslexia (Rose, 2009). It is evident that the most substantial changes are in widening the range of characteristics of dyslexia still further, distilling its primary features into a comprehensive, working definition:

- "Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling;
- Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed;
- Dyslexia occurs across the range of intellectual abilities;

- [Dyslexia] is best thought of as a continuum, not a distinct category, and there are no clear cut-off points;
- Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organization, but these are not, by themselves, markers of dyslexia;
- A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well-founded intervention." (BDA, 2018)

For the purposes of necessarily grounding a research study in definitions of the principal ideas being explored, it is this BDA (2018) definition of dyslexia that has been chosen as the most appropriate. This is partly because this working definition is quite broad, but also because it includes two important features of the definition that are significant to this project: firstly, referring to dyslexia as a continuum supports the formulation of the Dx Profiler which has been designed and developed for this project to gauge levels of dyslexia-ness along a continuous scale; and secondly, it highlights co-occurring difficulties that are manifested by students with dyslexia at university, and which have been incorporated into the Dx Profiler. These co-occurring issues are discussed in sub-sections 2.1(VII) and 3.1(IV).

Significant in both the original and the current BDA definitions is an absence of any reference to dyslexia as a disability, learning, or otherwise. However, dyslexia is categorized as a disability by the Terms and Definitions of the Equality Act 2010, because the Act considers dyslexia to be a condition recognizable as “a mental impairment that has a substantial and long-term adverse effect on an individual's ability to conduct normal day-to-day activities” (Office for Disability Issues, 2011, p7). Dyslexia is referred to twice in the Guidance Notes (ibid), firstly as an example of a disability which can arise from impairments (Section A5, p9), and later as a condition which may cause an individual to develop coping or avoidance strategies which can fail in some circumstances (Section B10, p19). Translated into the environment of learning and study at university, this means that the premise of the Act supposes that a student with dyslexia - a hidden and not immediately obvious disability which is substantial and long-term - is assumed likely to be a learner who will find the conventional academic processes of university particularly challenging. Setting aside for the moment how dyslexic students may feel about being labelled as disabled, and more especially as ‘mentally impaired’ - which is discussed below in sub-section 2.1(IV) - the first immediate outcome is that such students will be eligible to apply for support through the Disabled Students' Allowance (DSA) in the UK. This a funding stream reserved for disabled students, which provides financial assistance to cover the purchase of equipment, resources and personal support with the aim of ensuring that study at university becomes as fair and equitable as possible in comparison to students with no disabilities. In 2015, the UK Government announced an intention to remove dyslexia as a qualifying condition eligible for consideration under the DSA, presumably because it was considered no longer appropriate to do so given the most contemporary views of dyslexia, despite it being indisputable that dyslexia is long term and persists into adulthood (e.g.: Bruck, 1992; Carawan et al., 2016). As a consequence of lobbying from parent groups, individuals and not least, professional associations such as the BDA and the Association of Dyslexia Specialists in Higher Education (ADSHE) the decision was deferred for the academic year 2016/17, and remains unresolved.

Thus, at this time, students with dyslexia that have been identified and documented are able to apply for help with their studies through the DSA. This means that following a formal Needs Assessment, usually conducted by a Disability Needs Assessor either at the student's university or at a specialist centre nearby, a list of recommended equipment and resources is drawn up. Typically this includes a laptop computer with specialist assistive technology software such as an advanced spell-checker or text-to-speech software, and a schedule of personal study assistance, most often study skills support tutorials designed to guide the student towards more easily managing the administrative, clerical and organizational tasks that are an essential part of study at university. However, the Equality Act 2010 also requires universities to provide reasonable adjustments to their physical environment, their operational procedures, curriculum delivery and assessment, and associated academic-related and administrative processes. At a practical level for the student with dyslexia, this typically may mean providing study areas that are differentiated from those more widely available for other students by being located in quieter environments with fewer distractions; ensuring that some computer workstations are equipped with specialist assistive technology applications; that Virtual Learning Environments (VLEs) are formatted to be easy to navigate with content that is easy to access; that additional time may be provided for students with dyslexia to complete formal examinations. Not least this recognizes that in the domain of adult learning at higher intellectually functional levels, (i.e. in HE), early-learning academic challenges that are functions of weaknesses in literacy skills have been shown to be often subsumed by later-learning organizational struggles that impact more substantially on learning confidence. This is in comparison with earlier learning difficulties where processes are developed to circumvent earlier learning weaknesses (Kirby et al., 2008), often through widespread use of study aids and support agencies or technology (Olofsson et al., 2012).

Thus, dyslexia remains a challenging condition to define, with a range of definitions that has emerged over a century of study, largely stemming from an interest in explaining why some children find learning to read particularly challenging in comparison to their peers (Lombardino & Gauger, 2014). For some children this may be through disadvantaged social backgrounds associated with low literacy levels (Snowling, 2012) or a low intellectual ability. But for others who do not appear to bring these challenges to their learning, the slow uptake in reading skills appears to be due to disturbances in elements of the cognitive processing of some sensory inputs (Stanovich, 2000). It is significant, therefore, that in relatively recent research, interest has refocused on gaining a better understanding of subtypes of dyslexia. One study which indicates some of the earlier theorizing about dyslexia from this perspective noted that there appeared to be evidence in developmental dyslexia of the subtypes more normally associated with acquired dyslexia - that is, through brain trauma (Castles & Coltheart, 1993). This suggests that there may be distinct dyslexia factors which may be more, or less prevalent in any single individual who presents dyslexia or a dyslexia-like profile. More recent work has taken dyslexia in adults as a focus and particularly, students in HE settings. Centred in The Netherlands, recent studies by Tamboer and colleagues (in particular Tamboer et al., (2014)) are extending the discussion by building on earlier research that focused on dyslexia as a multi-dimensional condition: Le Jan et al. (2009) explored symptoms of dyslexia in a group of elementary school children (n=113) to build a diagnostic tool based on an analysis of dyslexia characteristics to guide assessors to identify the presence of dyslexia or not. Eight variables from the four categories of metaphonological skills - awareness of the sound structures of spoken words (phonological awareness); awareness of word

structures and word inter-relationships (morphology awareness); the visual span of attention in reading (visuo-attentional capacities); and discerning differences in similar sounding syllables, for example between '~ti~' and '~di~' (discerning auditory contrasts). These variables were established as significant predictors of the likelihood of dyslexia being present. Pennington (2006) had previously suggested a multi-factorial cognitive deficit model to explain the causes of dyslexia which emerged from interest in explaining the co-morbidities of dyslexia with attention deficit hyperactive disorder (ADHD) and with speech sound disorder (SSD). One of the key findings suggested that although a multi-variate model did not achieve a thorough understanding of developmental disorders such as dyslexia, ADHD and SDD, it did help in explaining more about the "shared processes at the aetiologic, neural and cognitive levels" (ibid, p405) of such conditions. The focus of the Dutch studies was to explore more fully the factor structure of dyslexia to try to determine firstly whether understanding more about the subtypes of dyslexia can enable more effective screening tools to be developed for identifying dyslexia amongst university students, and secondly whether these are distinguishing features of dyslexic learners alone or they can be observed to varying degrees in other, even all students. This approach in attempting to understand dyslexia and how it might be identified more specifically in tertiary education settings is particularly pertinent to my study (see sub-section 3.1(IV)).

It might be argued that much of the problem in pinning down what dyslexia *is*, is a function of the way in which it is assessed. In the case of the literacy-related dimensions of dyslexia that are most noticeable in young learners, Stanovich in particular has repeatedly questioned the discrepancy approach used to measure dyslexia, insisting that when aptitude-achievement is used as the benchmark comparator, such a 'diagnosis' fails to properly discriminate between attributing poor reading abilities to dyslexia or to other typical causes (Stanovich, 1988, 1991, 1993, 1996, 1999, 2000). Elliott & Grigorenko (2014) brought this into the contemporary context by arguing that identifying dyslexia is so problematic that assessments of it may be irrelevant or at best, academically counter-productive. Notably, it has also been shown that students with dyslexia in HE may not be a homogeneous group due to the likelihood that several subtypes of dyslexia or dyslexia-like profiles may exist. Hence, any identification approaches need to be designed to respond accordingly (Tops et al., 2012). These issues are explored later (sub-section 2.1(VI)), where the discussion specifically expands on the problems and suggested solutions surrounding the determination of the extent of an individual's dyslexia. Hence, given the persistent debate surrounding the nature of dyslexia and which aspects of it might be measurable and for what purpose, assigning a metric to establish a worthwhile appraisal of dyslexia, dyslexia-like characteristics or dyslexia-implied study profiles in learning contexts is ambitious. It is Stanovich's view that domain-specific difficulties - for example, finding reading challenging, struggling with arithmetic - may be comorbid in many cases, but it is only helpful to group such difficulties under an umbrella term - such as 'learning disability' - after an initial domain-specific classification has been established (Stanovich, 1999). This is important, not least because this argument adds weight to the adoption of a factorial view of dyslexia, especially in academically capable adult dyslexics where many of the early-years' learning difficulties may have been displaced by strategically developed learning solutions but which may expose other dyslexia 'factors' as more influential in the learning processes that are commensurate with study at university.

Finally, it is worth observing that the Equality Act (UK) 2010 *attempts* to build on a recognition of the social model of disability, being one that views society as the disabling factor when people are physically impaired or different from most other members of that society. It considers dyslexia to be one of a family of unseen or hidden impairments which are counted as disabilities. But despite the clear intentions of the Act to focus on inclusion and access, dyslexia tacitly remains attributed to the individual, not least through a persistence to 'diagnose' it. This position might be argued to be more consistent with the now outdated medical model, where disability is implied to be the fault of the disabled person rather than resulting from situations and circumstances in society that are not adjusted to account for different abilities, either physical or hidden. Much of the research evidence explored and cited in this thesis persists in referring to a diagnosis of dyslexia. This is despite the contemporary view about dyslexia in learning environments more commonly implying that it is the structures and systems of delivery which should be considered as the disabling factor, and that as long as learning outcomes that assess intellect and academic aptitude remain based on high levels of literacy, learning barriers attributable to even a more positively-focused social construction of dyslexia are likely to remain, no matter how the syndrome is defined (Cameron & Billington, 2015). One of the significant outcomes of this study reports on how students learned of their dyslexia to try to find out more about the impact of being diagnosed and how this may be correlated with levels of academic confidence (see sub-section 4.3(II)).

II THEORETICAL STANDPOINTS OF DYSLEXIA

A brief overview of some of the most important theories about dyslexia are now presented. This will not be a discussion or a critical review of the theories, but instead aims to provide a backdrop of the main ideas about dyslexia as a framework that, together with the theoretical underpinnings of academic confidence presented later (sub-section 2.2), support the objectives of this current study.

Theories about dyslexia fall into several, broad categories: Attributing dyslexia to phonological skills and awareness differences is widely researched and supported, not least due to relevance in explaining reading difficulties in children. Explaining dyslexia as an outcome of visual differences or irregular visuo-attentional processing appears at the outset to be quite different and sometimes rather specialized, but these theories have also attracted substantial support. A more recent focus considers dyslexia as an example of natural human neurodiversity by placing it along a spectrum which is said to include, for example, autism and Attention Deficit Disorder (ADD). Other theories have tried to blend some of the well-substantiated explanations into a more comprehensive framework for understanding dyslexia by taking a neuro-biological standpoint; or to consider it as a multifactorial syndrome that presents a wide range of characteristics, attributes and differences, not only in learning and study behaviours but also more widely in everyday functioning. These will be taken in turn in an attempt to crystalize the most important features of each into short overviews, to briefly illustrate their theoretical roots and how they may be located in the domain of learning and teaching, especially in HE contexts.

1. DYSLEXIA IS A PHONOLOGICAL PROCESSING DISTURBANCE

This is a major theory of dyslexia, offering the explanation for reading difficulties as resulting from impairments in forming grapheme-phoneme correspondence: that is, understanding the connections between the forms of letters and the corresponding sounds that are represented. More

specifically, that the ability to blend or disassemble letter combinations, i.e., syllables and words, into or from their corresponding speech sounds is impaired (Brady & Shankweiler, 1991). In the phonological-core variable-difference framework, Stanovich (1988) argued that the primary difference between dyslexic and non-dyslexic individuals is evidenced by a deficiency in the cognitive dimension where phonological skills are located. This was said to explain differences in causes for delayed reading skills' acquisition between young people with a dyslexia and others who were more of the 'garden variety' of poor readers (ibid, p590), a term originally coined by Gough & Tunmer (1986) in a study about decoding, reading and reading disabilities. The idea is based on the argument that an individual with dyslexia has a cognitive deficit that is by-and-large, specific to reading. Were deficits to extend more widely into other cognitive areas of functioning, then such an individual would not be dyslexic but rather, a 'normal' poor reader. The most important point is Stanovich's contention that in dyslexia, the deficit is vertical in respect to the individual's inherent cognitive powers, and hence is domain-specific. This is in contrast to a more horizontally manifested deficit, which would be presented as extending across several cognitive domains. These might be attention and concentration, or visuo-spatial skills. This standpoint goes some way towards explaining why much of the earlier dyslexia research is rooted at the word-recognition level of phonological processing abilities. These are abilities which may include phonological decoding, inefficiencies in short-term memory processes, or in translating the written representation of phonemes into their correct sound segments, for example in properly distinguishing the vowel sound differences that are centrally located in (English) words such as b**oa**t, b**oo**k, b**oo**t. This difficulty impacts progressively when children advance from learning the individual sounds of letters and short letter combinations into blending these into words and hence challenges the development of reading skills, indicating that the link between phonological processing and acquisition of reading skills is causal (Wagner & Torgesen, 1987), although later research suggested that this relationship may be bi-directional. That is, it may equally be the actions of learning to read which enable phonological awareness (Hogan, et al., 2005, Brunswick, et al., 2012). However, the most important point is that although phonological deficits may also occur in non-dyslexic poor readers, their deficits may also extend into other domains (Stanovich, 1994).

But why do phonological processes impact so much on reading? It is beyond the scope of this thesis to engage with lengthy discussion about the components and processes that drive the acquisition of reading skills but the core idea of 'phonics' as a learning-to-read procedure is that it teaches children to match up the sound components of words with individual letters or letter groups, and consequently is also directly related to the simultaneous acquisition of spelling competency. For example, children will learn that the sound '***k'*** can result from a variety of letter or spelling sources: ***c***, ***k***, ***ck***, or ***ch*** (in English). In reverse, being able to spot letters and letter combinations in new words being learned enables a reader to decode the word into its component sounds and hence reconstruct the sound of the complete word. It follows therefore, that disturbances which affect any or all of these letter-sound coding-decoding processes will impact on a child's ability to convert text into speech whether out loud, in the learner's mind, or into writing. Essentially, this is the core of phoneme-grapheme-phoneme correspondence. Interference in this process is likely to be evidenced where children's' reading, spelling and writing skills fail to develop, principally in comparison with their peers and to expected levels of progress when taking into account other significant factors such as their inherent academic ability, socio-environmental or cultural factors. Hence a key advantage of considering dyslexia as principally identifiable through

core phonological deficits (Stanovich, 1986) is that it is relatable to what is commonly understood about the typical acquisition of reading skills (Snowling, 1998) and corresponding competencies in spelling and writing. Assessing individuals' capabilities in these key literacy skills through properly developed, well-established norm-referenced, procedures can be significant contributors to a dyslexia-identifying process, because the primary problem of reading-impairment in dyslexia is one of word recognition caused through weak phonological coding competencies (Stanovich, 1996).

However, understanding how phonological skills, reading writing and spelling, and dyslexia are interrelated is not in research stasis. Although it is fair to say that ideas continue to develop and evolve rather than emerge, such evolutions are incrementally advancing what is known about how reading and other literacy skills are acquired in the first place, and how these skills acquisitions might be adversely affected by disturbances that are inherent in some individuals, either attributable to dyslexia or to something else. As if this may not be challenging enough, it is compounded by rightly taking account of socio-environmental factors that have been shown to significantly impact on the development of literacy skills in early years, and finding out more about how these factors need to be accounted for in experimental design and research outcomes. For example, because pre-literate early learners' phonological skills develop out of auditory experiences, it follows that immersion in high-quality oral experiences at home and pre-school is likely to enrich and more readily enable these skills (Goswami, 2008). Conversely, it is reasonable to suppose that social disadvantage or deprivation is at the very least likely to delay the typically expected development of phonological skills, and hence competencies in literacy in early-years learners (Law et al., 2011). Amongst many, three important factors can be distilled as pertinent to this thesis: firstly that there is evidence that some individuals are not dyslexic ***enough*** for early-learning phonological deficits to have had a lasting impact on their literacy skills, and that it may be other characteristics of their dyslexia which emerge as debilitating in later learning (Ramus & Szenkovits, 2008). Secondly, some adults with dyslexia who had significant phonological deficits as children appear to have ‘recovered’ when these skills are re-assessed in adulthood (Goswami, 2003) either through the development of strategic compensations, or that their dyslexia has apparently ‘gone away’, which, on the basis of dyslexia being understood as a neurobiological condition or even as a neurodiverse situation, seems unlikely. Lastly, renewed interest in viewing dyslexia as a multidimensional condition (discussed below) as a way to explain the diversity of behavioural symptoms and also to bind together some of the more significant theories, is particularly enabling progress to be made in understanding how dyslexia impacts on adults’ engagement with learning in HE contexts.

2. Dyslexia is attributable to visual disturbances

Before the phonological processing theory of dyslexia emerged, dyslexia or *word-blindness* (Hinshelwood, 1896; Pringle Morgan, 1896) was thought to be primarily a visual processing defect which resulted from impairment of the visual system. This notion was later developed by Orton (1928) who coined the term ‘strephosymbolia’ to describe the tendency of some dyslexic readers to reverse letters (e.g. ‘b’ and ‘d’) and to swap the order of letters within words (so ‘was’ might be read as ‘saw'). Later still, Stein (1991) linked instabilities in binocular vision - which may create issues in visual tracking both across lines of text and from line to line – with impaired reading development (see also Bellocchi et al., 2013). Whilst it might be supposed that such physiological

disorders may appear unrelated to cognitive functioning from the phonological processing point of view of dyslexia, issues in following printed text accurately will make the reading and comprehension of it difficult, and hence may present similar symptoms of poor reading. Amongst others, Kirby and colleagues (2011) suggest that vision differences are likely to be the most significant underlying causes of dyslexia. This may, however, indicate a misunderstanding about how visual disturbances may be a factor in a dyslexic profile, and indeed, not necessarily a component in all dyslexic profiles. Stein and Walsh (1997) considered that a major issue in dyslexia is difficulty processing fast incoming sensory information effectively, whichever sensory domain it comes from. It is beyond the scope of this thesis to expound the details of the brain's visual system other than to summarize that magno cells, or M-cells (located in the thalamus), are part of the visual cortex of the brain that detects orientation, movement, direction and depth, and which directs eye movements to enable individuals to maintain steady fixation on a visual target. Research has shown that in some dyslexic readers' brains, M-cells are significantly smaller and more disorganized than those in the brains of non-dyslexic readers (Livingstone et al., 1991, Galaburda & Livingstone, 1993). It follows, therefore, that weak or abnormal development of this sub-structure of the brain will account for some reading challenges, especially in the early development of reading skills where clear perception of the orthography of a written language is key to comprehending the relationships between words and their sounds and meanings (Stein, 2001). The greater picture that relates dyslexia to visual disturbances through the magnocellular theory remains controversial, although research building on the earlier foundations of Stein continue to indicate that visuo-attentional processing issues may be at least one of the components of developmental dyslexia (Bellocchi et al., 2013). It is notable however, that visual differences described as jumping letters, fizzing text and dancing lines, although common in many individuals with dyslexia, are equally absent in others (Shovman & Ahissar, 2006), with another study reporting that in assessments of visual target detection, dyslexic readers' performance showed no difference in comparison to that of non-dyslexic readers (Hawelka & Wimmer, 2007).

The issue may be further conflated because other less fundamental visual disturbances can also impair access to print. Of these, visual stress (ViS), scotopic sensitivity, or Meares-Irlen Syndrome (MIS) may be examples of distinct but possibly related conditions that sometimes occur alongside dyslexia rather than are indicators of the syndrome. Typically presented as heightened sensitivity to lighting glare or contrast differences, other vision issues can also make reading challenging. These can include restricted fields of vision, which make only small areas of text become properly in focus, or challenges in maintaining focus on text for a sufficient time to properly enable comprehension (Irlen & Lass, 1989). Visual stress has been shown to be more of a visual processing issue rather than an optical dysfunction which can occur widely rather than specifically amongst individuals with dyslexia (Wilkins, 1995). Claims that MIS may have higher levels of prevalence amongst individuals with dyslexia than in the general population (Singleton & Trotter, 2005) are difficult to verify, not least because evidence more usually points towards dyslexia and MIS being comorbid conditions rather than causally related (Kruk et al., 2008), although either way, this may suggest that a higher prevalence of these conditions might be expected amongst dyslexic readers. Kriss and Evans (2005) supported this comorbidity idea but found that there was only a slightly higher prevalence of MIS amongst individuals with dyslexia in their study in comparison to their control group. Another recent study exploring dyslexia in a substantial sample of French schoolchildren (n=275) found that those who presented comorbid phonological and visual deficits

did not show a more significant reading disability than those with phonological deficits alone (Saksida et al., 2016). Nevertheless, assessments of visual stress have been frequently included in dyslexia screening tests in recent years (Nichols, et al., 2009) and their use is common in educational contexts to ameliorate vision differences, notably in universities (Henderson et al., 2014). Placing tinted colour overlays on to hard-copy text documents and use of assistive technologies that create a similar effect for electronic presentation of text to relieve some of the symptoms of visual stress have been long-standing recommendations in students' Disabled Students' Allowance Assessment of Needs, indicated by anecdotal evidence at least. However, evidence that this solution for remediating visual stress is more useful for those with dyslexia than for anyone else who experiences MIS or ViS is variable (e.g.: Henderson et al., 2013; Uccula et al., 2014). Ritche et al. (2011) found that coloured overlays had no significant or immediate effect on reading ability in poor readers although their sample was small. Their conclusions were endorsed however, by a significant review of a substantial number of studies, which concluded that apparent improvements in reading fluency as a result of the use of coloured overlays may be more likely due to placebo, Hawthorne and novelty effects (Griffiths et al., 2016). Even more significantly, one study found that use of overlays can actually be detrimental to reading fluency, particularly in adults (Denton & Meindl, 2016). Thus although the relationship between dyslexia and visual stress remains unclear, there is evidence to indicate that there may be an interaction between the two conditions which can have an impact on the remediation of either (Singleton & Trotter, 2005) and even though measurable improvements in reading fluency in individuals with dyslexia through use of coloured overlays or assistive technology applications that do the same may be difficult to attribute to anything other than the placebo effect, if students feel that they are gaining benefits, this alone builds an argument to support their continued use.

3. Dyslexia is a rapid auditory processing disturbance

This theory takes the view that the specificity of the difficulties in phonological awareness and processes are secondary to more fundamental issues with auditory processing. Pasquini et al. (2007) outlined several auditory impairments that had been suggested as contributing to phonological processing difficulties, and that as a result, offer another dimension to explanations for reading difficulties. These were auditory impairments most specifically related to deficits in the perception of short or rapidly varying sounds (cf Stein and Walsh's earlier work on the processing of fast incoming sensory information). Early work examining auditory discrimination capabilities between reading-impaired and control children had found a strong correlation between errors in nonsense word reading (to assess phonics skills) and errors in responding to rapidly presented auditory information (Tallal, 1980). This led to an hypothesis that some reading difficulties may be linked to low-level auditory perception disturbances, affecting the ability to learn to use phonics skills. Subsequent studies also found evidence amongst dyslexic children for poor auditory discrimination of certain sound contrasts in phonemes such as '~ba~' and '~pa~' (Adlard & Hazan, 1998; Serniclaes et al., 2004; Goswami et al., 2011). In characterizing dyslexia by unexplained difficulty in reading, Temple and colleagues used functional MRI with a group of children (n=32, dyslexic and non-dyslexic) to firstly confirm earlier studies which had indicated neural differences during phonological processing between dyslexic and the non-dyslexic individuals (e.g.: Temple et

al, 2001), and secondly to show that a remediation programme which focused on auditory processing and oral language training was able to ameliorate disrupted neural function in brain regions associated with phonological processing (Temple et al., 2003). But the relationship between auditory differences - whether these be classified as impairments, deficits or dysfunctions - and dyslexia remains a debated topic although it is reasonable to suppose that firstly, individuals who present with auditory processing challenges are likely to see these impact on their phonological awareness; but secondly, that care must be taken to understand the distinction between auditory impairments and auditory *processing* impairments, where the first is concerned with the physical capabilities to hear sounds and the second is about how accurately acquired acoustic information is subsequently interpreted by the brain. Although both seem distinctly but equally likely to impact on the development of phonological skills and hence reading abilities (Witton & Talcott, 2018), is it beyond the scope of this study to consider these more deeply.

4. Dyslexia results from a mildly dysfunctional cerebellum

Emerging from earlier research grounded in an automatization deficit theory where individuals with dyslexia were found to have reduced performance in comparison to controls on tasks where balance had to be maintained whilst undertaking another task (Nicholson & Fawcett, 1990), the cerebellar deficit theory of dyslexia (CDT) was extended to include issues related to time estimation that were said to be reduced in dyslexic children (Nicholson et al., 1995). These ideas were consolidated into an hypothesis for the cause of developmental dyslexia arguing that disorders of cerebellar functioning, presenting as reading and writing difficulties, may be a factor in the explanation of dyslexic learning differences. (Nicholson et al., 2001). This idea is interesting, not least because it attempts to relate the major behavioural symptoms of dyslexia in children at least, to issues with automaticity in linguistic capabilities which need to be refined to enable fluent reading - and associated comprehension - writing, and spelling. Figure 1 provides a summary of the logic of the theory, showing how features of cerebellar impairment and functioning might explain typically presented characteristics of dyslexia. The theory also offers explanations in part at least, for the higher-than-normal predisposition towards weaker motor control competencies sometimes observed in dyslexic children (Fawcett & Nicholson, 1995). Whether this is evidenced by poor handwriting in children with dyslexia may be uncertain, where although one study demonstrated reduced handwriting competencies in dyslexic children (Mattlew, 1992) further evidence is sparse. Another study identified that one reason why dyslexic children appear to be slower writers than their non-dyslexic peers could be attributed to them pausing more often during their writing processes, which was found to be related to their spelling competencies (Sumner et al., 2013). This is a link not established in Nicholson & Fawcett's (2001) model. The CDT process chain does, however, also provide an acknowledgement of the phonological awareness issues associated with dyslexia by including these into the theoretical representation through what is termed the 'word recognition module' as a precursor to reading and spelling. Critics of the theory have had difficulty in reproducing the earlier evidence of compromised automaticity in the dual-task balancing experiment with children with dyslexia, where results suggested a confounding factor between dyslexia and ADHD and that this may have unknowingly compromised earlier findings (Wimmer et

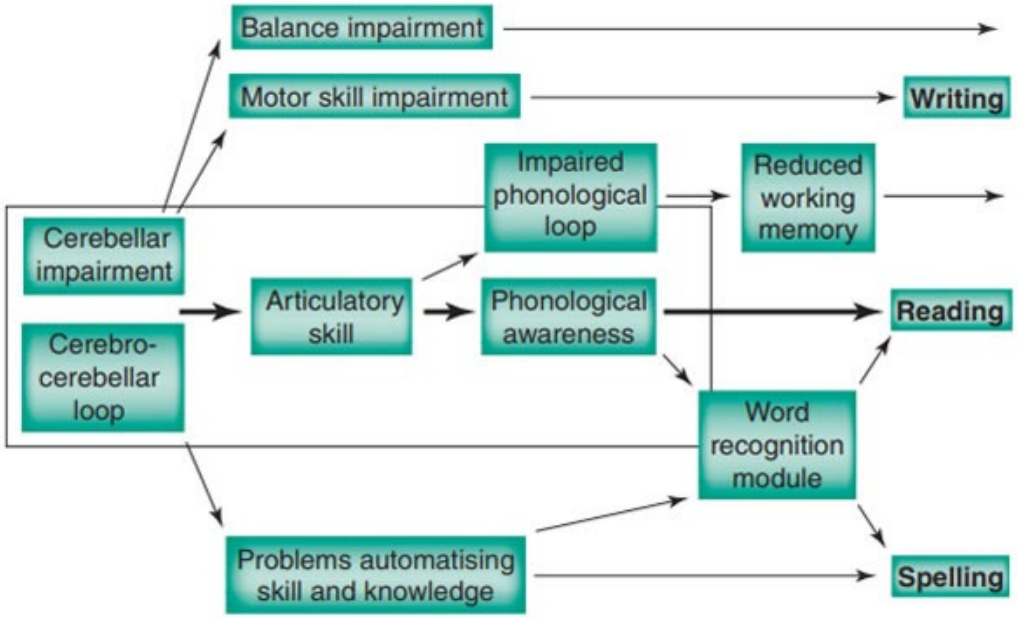


Figure 1: Process chain indicating components of the cerebellar deficit theory of dyslexia (adapted from Nicholson et al., 2001, p510).

al., 1999). Further, Ramus et al. (2003) were only able to provide partial support for the cerebellar deficit theory, finding that only half of the dyslexic children in their study presented any significant motor control challenges and that no evidence was found which linked motor skills to phonological and reading skills. However, their study did concede that those with dyslexia, as well as those with other developmental disorders (including ADHD), may evidence greater challenges in activities that require finer motor control skills than may be witnessed in children who are not affected by such disorders.

5. Dyslexia is a manifestation of natural human diversity:

An alternative viewpoint about the nature of dyslexia constructs the syndrome in the context of 'neurodiversity'. The BRAIN.HE project (2005), now being revised but with many web resources still active and available, hailed learning differences as a natural consequence of human diversity, and suggested that dyslexia is amongst so-called 'conditions' on a spectrum of neuro-diversity which includes ADHD and Asperger's Syndrome (Pollak, 2009). This view supports the argument that individuals with atypical brain 'wiring' are merely at a different place on this spectrum in relation to those others who are more 'neurotypical'. The greater point here is well put by Cooper (2006), drawing on the social-interactive model of Herrington & Hunter-Carsch (2001), with the idea that we are all neurodiverse and that it remains society's intolerance to differences that conceptualizes 'neurotypical' as in the majority. This may be particularly apparent in learning contexts where delivering the curriculum through a largely inflexible literacy-based system discriminates against particular presentations of neurodiversity (e.g.: Cooper, 2009). One of the most significant features of the neurodiversity approach towards understanding dyslexia is a fundamental recognition of the syndrome's strengths in many areas of human functioning as well as acknowledging weaknesses in others. Armstrong (2015) argues that this means taking a more judicious approach to identifying and labelling cognitive or mental differences as disorders or disabilities, especially in the domain of education and learning. Further, that curriculum provision should be adapted in ways that enable and empower the neurodiverse student to flourish rather than be identified as different from their

peers, not least through removal from mainstream into differentiated learning situations (Armstrong, 2012). It is notable that this construction of dyslexia resonates with the concepts of Universal Design for Learning, outlined earlier, and below (sub-section 2.1(III)).

6. Describing dyslexia using a multifactorial approach:

A significant body of recent work has attempted to understand dyslexia using a multifactorial approach, largely built on an early study (Castles & Coltheart, 1993). This argued that attempts to understand the aetiology of dyslexia using a phonological deficit model, or alternatively, where the observed symptoms were physiological and principally vision-related, were simplistic. Therefore, a more comprehensive perspective, based on the acceptance that dyslexia may be a *variable* rather than a *determined* learning circumstance, may be a better model. Although this study focused on reading deficiencies in children and took no account of wider differences in learning approaches that are now known to be apparently associated with dyslexia in adult learners, the study was important because even within the scope of its focus, it appeared to identify two distinct subtypes of reading difficulties with one accounted for by deficits in whole-word recognition whilst the other by deficits in gaining a good grasp of letter-to-sound rules (ibid). This is important because the conclusion was that individuals, (that is, children, it is assumed), who present developmental dyslexia do not form a homogeneous group. Therefore, it is reasonable to argue that different varieties of dyslexia are likely to exist, all distinctly characterised by a different blend of 'deficits' in comparison to the 'norm'. A later study, which did not appear to draw on this work by Castles and Coltheart, but where the outcome certainly adds value to their work, took a logical deductive approach to argue that dyslexia is a multifactorial condition, where any number or combination of *causes* can lead to the same outcome. Therefore, it follows that dyslexia should be best considered as a ‘multiple deficit’ syndrome (Pennington, 2006). One study that *was* considered in a brief review of prior research on dyslexia as a multiple deficit syndrome identified it as being characterised by a ‘weighted profile’ of deficits (Vellutino et al., 1991). Weighted profile in this context is cognate to the concept of a weighted mean average in statistics. This is pertinent to this current study because the research design (see Section 3) also adopts the weighted profile approach to describing the blend of dimensions which constitute a learning and study behaviour profile of university students ascribed a level of dyslexia-ness.

A later study of dyslexia in French schoolchildren highlighted that it may be possible to identify dyslexia on the basis of several, apparently independent cognitive variables without assessing reading or spelling deficits (le Jan et al., 2011). This was shown to be achievable by building a predictive, multivariate model of variables drawn from cognitive categories which included memory, visual-attention span, selective attention and auditory components. This is interesting because it detaches some of the basic literacy-skill dimensions from an identification process for dyslexia, and concentrates instead on alternative attributes of the syndrome, not least drawing from some of the theories outlined above. This is arguably the most appropriate focus to adopt for understanding dyslexia in HE where, in generally academically capable university students, anecdotal evidence at least, suggests that many early literacy issues can have been partially mitigated, either through individual strategic management of them, or through use of assistive technologies. Furthermore, studies with Dutch university students ‘described’ dyslexia (as opposed to ‘diagnosed’ it) in adult learners at university using five factors determined through a principal component analysis of a

wide range of dyslexia dimensions (Tamboer et al., 2016). This is pertinent because it shows how useful factor analysis can be as a mechanism for identifying families of independent dimensions that together, might be an effective identifier of dyslexia in certain circumstances. The process had also previously been used to identify latent variables (i.e. factors) in a study exploring phonological and visual-attention differences in French and English children (Bosse et al., 2007) and on differences in rapid automized naming tasks in Italian children (Di Filippo & Zoccolotti, 2012). But secondly, demonstrates that in HE contexts, self-report questionnaires can serve as reliable identifiers of dyslexia in university students (Tamboer et al., 2014), This was a fact also suggested by Chanock et al. (2010) in their appraisal of a standard battery of diagnostic tests for dyslexia which they had found to be lacking in both sensitivity (correctly detecting dyslexia in known dyslexic students) and specificity (detecting dyslexia correctly in non-identified students), where their own, self-report questionnaire performed better for both parameters. As will be described later (Section 3), both of these elements of research design - using a self-report questionnaire to gauge dyslexia, and principal component analysis of dyslexia dimensions - are key to addressing the research hypotheses being examined in this current study.

Additional, interesting features also emerged from Tamboer and colleagues' (2016) study, not least their interpretation about how to measure the *severity* of dyslexia, and why to do so might be meaningful. Dyslexia severity was determined through a logistical regression analysis that classified the students in their sample (n=446) without considering which factors of dyslexia were to be taken as more significant than others. In this way, it was possible to sub-divide their sample into three, distinct subgroups: students with dyslexia; students with a very low likelihood of dyslexia; and thirdly, students who brought with them no prior diagnosis of dyslexia but who were presenting many of the characteristics of dyslexia typically associated with formally identified dyslexic university students. This also resonates with the research design in this current study where 'severity of dyslexia' is interpreted as a 'level of dyslexia-ness', and the design relies on establishing three subgroups of students, defined similarly: dyslexic students; non-dyslexic students; *quasi*-dyslexic students – equivalent to the third subgroup in the Tamboer study. Finally, it is apposite to report the nature of the five factors established in Tamboer's studies due to the similarities between these, and as will be reported later (in Section 4), the factor analysis applied to the data collected in this study which also identified five factors of dyslexia that made sense in university-learning contexts. Tamboer's five factors were distinguished as: spelling; phonology; short-term memory; confusion; and complexity; determined through a reduction of 17 dyslexia dimensions, whereas for the data collected in this study's similar sample of university students (n=166), the factor analysis reduced 20 dimensions into five factors designated as: reading, writing, spelling; verbalizing and scoping; working memory; organization and time-management; and thinking and processing.

Further work consolidated these Dutch studies into a dyslexia screening tool designed for use with university students or more widely with adult learners (Tamboer et al., 2017). The screener built on the power of factor analysis to generate components of dyslexia which appear to be stable and robust discriminators, and also strongly relied on the contribution of a self-report questionnaire to the final outcome of the screener, which was reported to have a high construct validity and a predictive validity that was even higher than that of the screening tool's tests (ibid). Both of these findings augured well for the research design for this current project. Significant due to its similar

focus, and also arising out of work with Dutch university students, are other studies which have searched for better screening tests for dyslexia in HE contexts. Notable amongst these, Tops et al. (2012) conducted a study which took the novel approach of pairing dyslexic and non-dyslexic students as the means to establish Test and Control group data and they administered a large number of verbal and non-verbal tests to establish comparisons across the student-pairs. The aim was to discover which tests were the most valuable to include in a dyslexia screener by having the most effective discriminative power. Where this is interesting and pertinent to this current study is twofold: firstly, and contrary to the findings of Tamboer's studies reported above, Tops and colleagues arrived at just three sub-tests in their proposal for an effective screener which were all components of reading-writing skills: word reading; word spelling; and phonological awareness. Secondly, the research analysis processes of that study also added substance to the research design of this current project, notably because analysis was focused on a correlation matrix of effect sizes. A similar process has been adopted in this current study, not least as a means to understand more clearly the significance of interrelationships between factors of dyslexia and factors of academic confidence. Hence, the study by Tops et al. (op cit) sets a useful data-analysis precedent and although the sophistication of their statistical processes stretches beyond this current study, it nevertheless indicates that the approach being adopted broadly follows a precedent. Finally it should be acknowledged that Tops et al. emphasized that although the three tests their study proposed as sufficient to provide the necessary discriminative power for identifying a possible dyslexia in a university student, they were not suggesting that these were the *only* areas where significant differences between dyslexic and non-dyslexic students were apparent in HE. Nor was their study pointing to the causes of dyslexia, rather, the focus was on the predictive capacity of the screener. The stance of the study tacitly questioned the relevance of a dyslexia-identifying process at university, by leaving as ‘open’ the purposeful value of such a process, especially since a substantial proportion of students with dyslexia in their datapool had attributes and characteristics (i.e. deficits) which deviated significantly from the general pattern. This is concurrent with the continuing challenges that prevail in establishing a concrete definition of what is meant by 'dyslexia', not least because this may be context dependent. It also alludes to the idea that rather than persist with a focus on identifying individuals whose profiles are atypical so that compensations might mediate their differences, adjusting their learning environment in ways which would enable them to be more readily accommodated would be preferable.

BINDING THEORIES OF DYSLEXIA TOGETHER – FRITH’S MODEL:

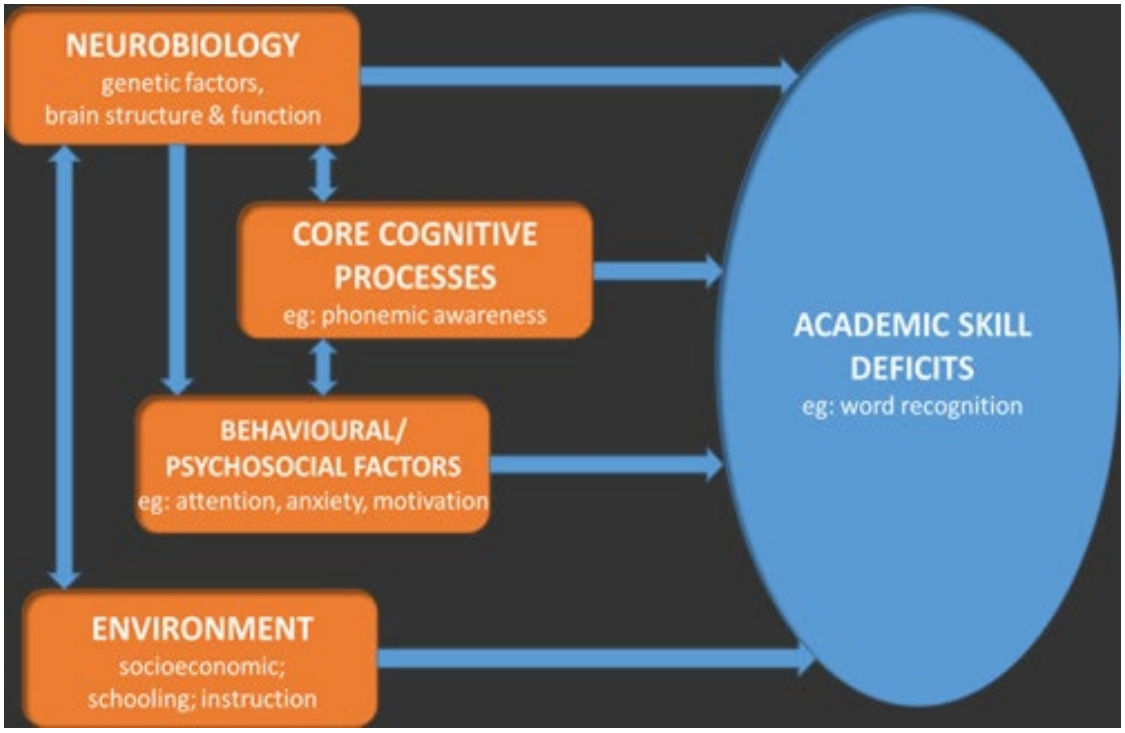
Before moving forward to a wider discussion about the impacts of dyslexia on individuals, and particularly the ways in which the syndrome affects their capabilities to engage effectively with learning, it is useful to reflect briefly on Frith’s (1999) causal modelling framework which endorsed earlier work arguing that dyslexia should be considered as a syndrome, characterized by a wide diversity of symptoms, indicators, dysfunctions, differences and challenges; these are typically exposed when individuals both young and not-so-young engage in learning activities. Taking the standpoint that dyslexia is a neurobiological condition, Frith suggested that this means blending together three broad churches of theoretical postulation: 1. Dyslexia is a biological condition because it has a basis in the brain and that there are genetic, heritable factors which, to some extent, demarcate the dyslexic brain from the non-dyslexic one (also: Pennington, 1990; Ohlson et al., 2014; Swagerman et al., 2017). 2. Dyslexia is representative of cognitive differences which are

frequently demonstrated by measurable anomalies in information-processing capabilities in comparison to standardized norms, for example in assessments of working memory (e.g.: Jeffries & Everatt, 2004) however it has been shown that understanding the impact of dyslexia on working memory is complex, not least because it depends on which domains of memory capabilities are assessed (Pickering, 2012), or of phonological skills (e.g.: Rack, 2017) when compared with the range of competencies observable in the majority of people. 3. Dyslexia may be evidenced principally by early learning-behaviour differences, not least delay in acquiring early reading skills in comparison to peers, and by associated weak spelling competencies (e.g.: Stanovich, 1994).

These three levels of Frith's framework are suggested to be, if not bound together by, then at least linked by environmental factors, which can both contribute to and be influenced by each or all of the biological, cognitive and behavioural factors. For example, in supporting a university student to develop an effective strategy for becoming more systematic in searching for information resources, although this may become a mechanism to facilitate greater methodical effectiveness, it may also be a remediation of the *symptom* of being muddled and disorganized rather than a 'cure' for the underlying difficulty, which may have its roots in the student's dyslexia. Conversely, an explanation for a child who is a poor reader might be attributed to elements in the child's socio-cultural background such that the typical early comprehension of the alphabet may have been delayed, being an environmental factor and nothing to do with dyslexia at all. The most important idea to emerge out of Frith's analysis is that to focus on any one of the three levels to the exclusion of the others in an attempt to explain dyslexia would be erroneous and unscientific, flying in the face of substantial evidence accumulated from a range of studies of dyslexia at all three levels. Ramus (2004) extended Frith's framework by carefully reconsidering earlier neurobiological data to suggest that not only can the model be used to bring together the phonological and magnocellular (vision differences) theories of dyslexia, but that it may also be applicable to other functional differences observed, for example, in developmental dyscalculia and in ADHD. Fletcher et al. (2007) appear to have adapted Frith's model to visualize the competing/contributory factors that can constitute a dyslexic profile by focusing on not only the integrability of Frith's earlier three factors, but also heightening the bidirectional relationship between the neurobiological and environmental factors (Figure 2). Fletcher's adjustments to Frith's model indicate the view that cognitive processes and behavioural and psychosocial factors are within the envelope of the neurobiology of dyslexia, with 'the environment' as more discretely related.

This is a only a subtle re-interpretation, as Frith's original model implies these to be sequentially organized strata which were placeholders for the various component parts of a dyslexia causation process. For example, in describing dyslexia as a phonological deficit, the causal chain may start in the 'biological' layer by suggesting a left-brain hemisphere disconnection as the root, leading to a phonological deficit in the cognitive layer which generates poor phoneme awareness as one of the behavioural characteristics. It is acknowledged that there is more to it than this, notably that genetic disorders are said to account for the biological level in the model having only one node (Morton & Frith, 1995). Embracing this causal chain are environmental factors such as teaching methods and literacy values (Frith, 1999, p203). Fletcher’s interpretation is useful because it directly indicates

Figure 2: Competing/contributing factors which may constitute a dyslexic profile (adapted from Fletcher, 2009, p511)



the outcome of the causal factors as academic skills deficits that be be observed in dyslexic learners.

Finally, it is of note that attempts have been made to compare and contrast the competing theories of dyslexia with an intention to explore whether they may be conjoined into a single, broad explanation for dyslexia rather than to favour one theory at the expense of the others. For example, Ramus et al. (2003) conducted an intriguing case study with a small group of 17 dyslexic university students and a control group of 17 students with no indications of dyslexia. The aim of the study was to evaluate dyslexia from all of the major theoretical perspectives to explore associations or dissociations which may imply causal relationships between the characteristics widely observable in individuals with dyslexia. A significant factor of the research design was the recruitment of academically capable adults as research participants. Although such individuals are not likely to be representative of the wider population of adults with dyslexia, by virtue of their intelligence, likely resourcefulness, possible social privilege, and that they may have benefited from good quality help with their early reading difficulties, the research is relevant to this current study due to its focus on university students as the participants. The tests used in the study were extensive, and devised to generate a comprehensive neuropsychological profile of the participants by cataloguing the outcomes of psychometric, phonological, auditory, visual and cerebellar evaluations. However, the results revealed no significant relationship between auditory and phonological deficits despite a strong correlation between these domains' data. In the dyslexic group a greater diversity of outcomes was recorded in auditory assessments, whereas more uniform results were obtained across the group in the phonological tests. The conclusion was that auditory performance is not a predictor of phonological performance. Overall, the study re-affirmed the widely held view that the most significant issue for individuals with dyslexia is in phonological skills with impaired capabilities being observed in all of the students with dyslexia. The incidence of deficits in the other components were variously observed in the dyslexic students in the sample, leading to a conclusion that some of these are not so much causes of phonological deficits but may aggravate them. Thus, this study is important partly due to the significance of its research design as a

comparator of the major theories of dyslexia but also because it deliberately took dyslexia in university students as the focus which resonates with the project being reported in this thesis.

III EQUITABILITY IN LEARNING SYSTEMS – ACCOMMODATING DYSLEXIA?

From sketching out an overview of the main theories about dyslexia, this sub-section now considers briefly how students with dyslexia are accommodated in learning systems. This is important because by first understanding more about how such students are 'managed' at university, this leads to a discussion (below) about the impact and stigma of learning differences labelling, and how this, and the processes used for identifying dyslexia may impact on those students being assessed.

Both 'difficulty' and 'disorder' are loaded with negative connotations that imply deficit, particularly within the framework of traditional human learning experiences and curriculum delivery environments that remain predominantly 'text-based'. This is despite the last decade or two of very rapid development of alternative, technology or media-based delivery platforms, embraced by an information society that sees news, advertising, entertainment and 'gaming', government and infrastructure services - almost all aspects of human interaction with information - being delivered through electronic mediums. And yet formal processes of education largely remain steadfastly text-based which, although now broadly delivered electronically, still demand a conventional ability to properly and effectively engage with the printed word, both to consume knowledge and also to create it or to demonstrate understanding. This persistently puts learners with dyslexia - in the broadest context - and with dyslexia-like learning profiles at a disadvantage and hence is inherently unjust. Cavanagh (2013) highlights this tardiness in the delivery of education and learning to keep up with developments in information diversity by candidly observing that the fields of pedagogy and andragogy should recognize that, rather than learners, it is curricula that are disabled, and hence need be adjusted.

Cavanagh is one of the more recent proponents of a forward-facing, inclusive vision of the barrier-free learning environment which is the Universal Design for Learning (UDL) (Rose & Meyer, 2000). UDL is attempting to tackle issues of justice in learning in ways that would declare dyslexia as at worst, a learning difference amongst a plethora of others, rather than a learning deficit, difficulty or disability. As such, it is aligned with the construction of dyslexia as an example of neurodiversity outlined briefly above (sub-section 2.1(II)). With its roots in the domain of architecture and universal accessibility to buildings and structures, the core focus of UDL is that the learning requirements of all learners are factored into curriculum development and delivery so that every student's range of skills, talents, competencies and challenges are recognized and accommodated without recourse to any kind of differentiated treatment to 'make allowances'. Hence it becomes the norm for learning environments to be much more easily adaptable to learners' needs rather than the other way around. This will ultimately mean that the text-related issues, difficulties and challenges that are undoubtedly due to deficits in some individuals and which can adversely impact on their successful engagement with conventional learning systems, will cease to have much impact in a UDL environment. There is an increasing body of evidence to support this transition in learning design, not least through attention being focused on the learning-environment challenges facing different learners. This ranges from building in equitable accommodation of learning difference into the exciting new emphasis on developing STEM education (e.g.: Basham & Marino, 2013), to

designing learning processes for including all students into health professions courses (e.g.: Heelan, et al., 2015).

However, other measures remain necessary to ensure an element of equitability in learning systems that fail to recognize and accommodate learning diversity. One route that outwardly seems attractive, draws on the idea that matching teaching approaches to students' learning preferences has merit. Extensive earlier, and recently revisited research on learning styles has demonstrated that when teaching styles are aligned with student learning styles, the acquisition, retention and later re-application of knowledge, can be more effective, fostering better learning engagement (Felder, 1988; Zhou, 2011; Tuan, 2011; Gilakjani, 2012). Moreover, a mismatch between teaching, and learning styles can cause learning failure, frustration and demotivation (Reid, 1987; Peacock, 2001). However, the conclusions of studies that have explored relationships between dyslexia and learning styles have lacked consistency. For example, in a cohort of 117 university students with dyslexia, no link was established between any preference for visuo-spatial learning styles and dyslexia (Mortimore, 2003); this may seem unexpected in the light of later research demonstrating a preference in dyslexic students for knowledge to be presented visually (Mortimore, 2008), and other research suggesting that one of the characterising aspects of dyslexia can be elevated visuo-spatial abilities in certain circumstances (Attree et al., 2009; Brunswick et al., 2010). Indeed, professional practice in university level support for dyslexic students regularly advocates, and subsequently provides assistive learning technologies such as concept-mapping tools that are designed to make learning more accessible for those with visual learning strengths (Draffan et al., 2014).

This continues to be a central provision of technology support for dyslexic students in receipt of the (UK) Disabled Students' Allowance, despite evidence suggesting that some alternative means to provide easier access to learning for dyslexic students appears to have equal learning value to both dyslexic and non-dyslexic students (Taylor et al., 2009). Indeed, whether it is desirable to integrate student learning style preferences, however these may be categorized or defined, into pedagogic design has attracted mixed support, although the more recent move towards a mass HE system appears to have generated a renewed interest in learning styles, not least as means to accommodate the much wider diversity of student communities at university (Smith, 2002).

The later advent of social media as a learning device, or at least as a learning enabling device, may have reduced interest in analysing learning styles per se. This is because the more personal nature of accessing learning resources that is permitted in, for example, multimodal, mobile cloud computing technologies has enabled students with dyslexia to engage with their learning resources in ways to suit their individual learning preferences (Alghabban et al., 2017). This may be especially the case where such learning resources have been accessed through social media portals, possibly lessening responses to improving learning access at institutional levels. Hence, adapting teaching to suit learners is being achieved without recourse to finding out in detail how learners prefer to learn. This approach to presenting more personalized learning experiences is enshrined through the advent of Smart Learning Environments (SLEs), echoing the ethos of UDL. An SLE has been defined as a learning place which features widespread incorporation of innovative technologies to permit greater flexibility, adaptation, engagement and feedback for learners (Spector, 2014); these are learning environments which, by turning around the idea of

curriculum delivery into curriculum uptake, foster student engagement at a highly personalized level. For those with learning differences in whatever form, this approach is likely to ameliorate many of their current challenges (Lenz et al., 2016), and hence make learning fairer and more equitable so that 'difference', 'disorder', 'difficulty', and 'deficit' will have much reduced relevance in a such a learning environment.

IV LABELS, CATEGORIES, DILEMMAS OF DIFFERENCE, INCLUSIVITY

The issue of difference has a long history both in education and in society more generally. Amongst communities of learning, educationalists and practitioners have agonized about how best to deal with learners who are 'different' without stigmatizing them on the basis of their difference. It should be taken as a ‘given’, that education and learning should inhabit a space in which prejudice is absent, in which everyone is treated fairly and non-judgmentally, where discrimination is not tolerated, especially where equality of opportunity underpins educational provision. Nevertheless, identifying a trait of difference - where this is established by a dominant, majority group - will risk emboldening a conceptual separation based on that trait; conversely, non-identification of minority groups or a non-acknowledgement of difference equally risks discrimination through the application of majority norms and perspectives without regard for the possible alternative needs of a minority (Minow, 1985). Such is the dilemma of difference which has driven the inclusion/exclusion debate in education since it was recognized that not all learners learn in the same ways, and hence that traditional, conventional teaching and curriculum delivery may not be suited to all learners. However, inclusion is variously conceptualised in educational contexts (Messiou, 2017) ranging from being primarily concerned with disability and special education needs, to defining inclusion as an objectively standardizing approach to education and society through the adoption of values such as equity and respect for diversity (Ainscow et al., 2006). Messiou focuses on Ainscow’s principled approach to defining inclusion adding that in practice, this means more than talking about the facilitation of active involvement and participation in learning contexts because it should embrace the wider concepts of presence and achievement as well as 'where' and 'how' children are educated. In other words, focusing on all students rather than on differentiated groups (op cit), which implies that to do otherwise may lead to marginalization and feelings of 'otherness' (French & Herrington, 2008; Mortimore, 2013).

In the face of this being quite a convincing social justice perspective on inclusivity in education, by taking a reactionary and critical standpoint, it might be argued that there is an alternative, well-rehearsed polemic that has sought to justify the categorization of learners as a convenient exercise in expediency. That is, as essential for establishing rights to differentiated 'support', this being considered the most efficacious form of intervention as a mechanism which outwardly at least, is designed to meet the different learning needs of minority groups (Elliott & Gibbs, 2008). This is support which aims metaphorically to shoe-horn a learner labelled with 'special needs' into a conventional learning box. In HE contexts, this may be through the application of 'reasonable adjustments' to curriculum access as a remedial process to compensate for learning challenges purportedly attributed to these individuals' apparent learning disabilities. Outwardly, this is neat, usually well-meaning, ticks boxes, appears to match learner-need to institutional provision, and ostensibly levels the academic playing field so that such learners can 'perform' in a fair and comparable way with their peers. An analysis of datasets provided by the Higher Education Statistics Agency (HESA) showed that this appears to work for most categories of disabled

learners in HE, also demonstrating that where some groups did appear to be under-performing, this was due to confounding factors unrelated to their disabilities (Richardson, 2009). However, even setting aside the undesirability of such solutions in the context of a properly inclusive practice, it is possible that such accommodations may positively discriminate against learners who present 'differences' leading to unfair academic advantage because the 'reasonable adjustments' that have been made were somewhat arbitrarily determined and lack scientific justification (Williams & Ceci, 1999). Indeed it has been reported that some students, witnessing their friends and peers in possession of newly-provided laptops, study-skills support tutorials and extra time to complete their exams, all of which has been provided through support funding, go to some lengths to feign difficulties in order to gain what they perceive to be an equivalent-to-their-friends, but better-than-equal academic advantage over others not deemed smart enough to play the system (Harrison et al., 2008; Lindstrom et al., 2011).

For dyslexia, there is some argument to suggest that, contrary to being associated with persistent failure (Tanner, 2009), attaching the label of dyslexia (however defined) to a learner can be an enabling and empowering process at university, exactly because it opens access to support and additional aids, especially assistive technology which can have a significantly positive impact on study (Draffan et al., 2007). It has been demonstrated that the psychosocial impacts of being designated as dyslexic have led some individuals to embrace their dyslexia and to identify and use many personal strengths in striving for success, in whatever field (Nalavany et al., 2011). Outwardly this seems to be strongly aligned with the neurodiversity approach; however Grant (2009) points out that neurocognitive profiles are complicated and that the identification of a specific learning difference might inadvertently be obfuscated by a diagnostic label, citing dyslexia and dyspraxia as being very different, but which share many, perhaps confusing similarities at the neurocognitive level. Ho (2004) argued that despite the 'learning disability' label being a prerequisite for access to differentiated provision in learning environments and indeed, civil rights protections, these directives and legislations have typically provided a highly expedient route for the tacit adoption of the medical model of learning disabilities by official channels and processes. This is where disability is considered as the disabled individual's fault - and hence enables institutions to pay less attention or even ignore completely their challenges in educational systems. One conclusion that may be drawn here is that wherever schools and universities persist in relying heavily on reading to impart and subsequently to gain knowledge, and require writing to be the principal medium through which learners can express their ideas and be assessed, explaining the poor performance of some groups by pathologizing them may enable institutions to avoid examining their own failures (Chanock, 2007). Although this might be viewed as a stinging appraisal of well-intentioned attempts to accommodate differences, it cuts to the quick of how the agendas of inclusivity ought to be both designed and properly implemented in learning institutions to ensure that equitable learning opportunities are provided for all.

Further arguments focus on stigmatization associated with 'difference': On the disability agenda, the relationship between disability and stigma is examined, with several studies drawing on social identity theory. Originally theorized by Tajfel and Turner (1979), it was suggested that part of an individual's concept of who they are, their self-identity, comes from their sense of belonging to a particular group, hence their social identity. Moreover, that as part of their group, individuals align themselves with group identity, norms, attitudes, and behaviours (Tajfel, 1982). In a later study

about disability identification, Nario-Redmond et al. (2012) supported the view that individuals may cope with stigma by applying strategies that seek to minimize stigmatized attributes, often accompanied by active membership of stigmatized groups in order to enjoy the benefit of collective strategies as a means of self-protection. An earlier study had identified the self-protective dimension of group attachments, especially where the group is representative of individuals marginalized by the wider society as a result of their difference, whether this be through disability or any other minority characteristic judged to be worthy of exclusion by the conformist majority (Crocker & Major, 1989). Social stigma itself can be disabling and the social stigma attached to disability is particularly so, not least due to a historical attribution of disability to the individual themselves - that is, adopting the medical model of disability which considers a disabling condition pathologically (Burch & Sutherland, 2006). However, there is a significant body of research that identifies disadvantages in all walks of life that result from the stigmatization of disabilities (e.g.: McLaughlin, et al., 2004; Morris & Turnbill, 2007; Trammel, 2009). Even in educational contexts and when the term is arguably softened to 'difficulties' or even more so to 'differences', the picture remains far from clear with one study (Riddick, 2000) suggesting that stigmatization may already exist in advance of labelling, or even in the absence of labelling at all, or that there is not necessarily a connection between labels of so-called impairment and the categorization of those who require additional or different provision (Norwich, 1999). Sometimes a stigma is more associated with the additional, and sometimes highly visible, learning support designed to ameliorate some learning challenges (Mortimore, 2013) - students accompanied by note-takers for example - with some studies reporting a measurable social bias against individuals with learning disabilities who were perceived less favourably than their non-disabled peers (e.g.: Tanner, 2009; Valas, 1999). Similar evidence relating to this kind of social bias was recorded in a study exploring the disclosure of dyslexia in cohorts of students who successfully entered university to train as nurses, which highlighted the unease of these student-nurses about their local learning communities becoming aware of their dyslexia (Morris & Turnbill, 2007). It is possible however, this may have been confounded by nurses' awareness of workplace regulations relating to fitness to practice, and how their dyslexia may very significantly reduce their likelihood of gaining employment. It has also been recorded that the dyslexia (learning disability) label might even produce a differential perception of future life success and other attributes such as attractiveness or emotional stability despite such a label presenting no indication whatsoever about any of these attributes or characteristics (Lisle & Wade, 2013). Perhaps of greater concern, is evidence that parents and teachers may have lower academic expectations of young people attributed with learning disabilities or dyslexia based on a perceived predictive notion attached to the label (Shifrer, 2013; Hornstra et al., 2014) and that in some cases, institutional processes have been reported to contribute significantly to students labelled as 'learning-disabled', choosing study options broadly perceived to be less academic (Shifrer et al., 2013).

Stanovich has written extensively on dyslexia, on inclusivity and the impact of the labelling of differences (e.g.: Stanovich, 1988; 1996; 1999; 2005). His position firstly is to promote debate about whether dyslexia per se exists, a viewpoint that has emerged from the research and scientific difficulties that he claims arise from attempts to differentiate dyslexia from other poor literacy skills; and secondly, given that dyslexia in some definition or another is quantifiable, argues that as long as the learning disability agenda remains attached to aptitude-achievement discrepancy measurement and fails to be more self-critical about its own claims, (Stanovich, 1999), its home in

the field of research will advance only slowly. Indeed, a short time later he described the learning disabilities field as “not ... on a scientific footing and continu[ing] to operate on the borders of pseudoscience” (Stanovich, 2005, p103). This position clearly advocates a more inclusive definition of learning disabilities to one which effectively discards the term entirely because it is “redundant and semantically confusing” (op cit, p350) a persistent argument that others echo.

Lauchlan and Boyle (2007) broadly question the use of labels in special education, concluding that aside from being necessary in order to gain access for support and funding related to disability legislation, the negative effects on the individual can be considerable and may include stigmatization, bullying, reduced opportunities in life and perhaps more significantly, lowered expectations about what a 'labelled' individual can achieve (ibid). Norwich (1999, 2008, 2010) has written extensively about the connotations of labelling, persistently arguing for a cleaner understanding of differences in educational contexts because labels are all too frequently stigmatizing and themselves disabling, referring to the 'dilemma of difference' in relation to arguments 'for' and 'against' curriculum commonality/differentiation for best meeting the educational needs of differently-abled learners. Armstrong and Humphrey (2008) suggest a 'resistance-accommodation' model to explain psychological reactions to a 'formal' identification of dyslexia, the 'resistance' side of which is typically characterized by a disinclination to absorb the idea of dyslexia into the self-concept, possibly resulting from more often, negatively vicarious experiences of the stigmatization attached to 'difference', whereas the 'accommodation' side is suggested to take a broadly positive view by making a greater effort to focus and build on the strengths that accompany a dyslexic profile, rather than dwell on difficulties and challenges. McPhail and Freeman (2005) have an interesting perspective on tackling the challenges of transforming learning environments and pedagogical practices into genuinely more inclusive ones by exploring the 'colonizing discourses' that disenfranchise learners with disabilities or differences through a process of being 'othered', or how difference or disability is a separatist construction that is then the submissive party in societal power and control relationships. Their conclusions broadly urge educationalists to have the “courage to confront educational ideas and practices that limit the rights of many student groups” (ibid, p284).

Pollak (2005) reports that one of the prejudicious aspects of describing the capabilities of individuals under assessment is the common use of norm-referenced comparisons. This idea is inherently derived from the long-established process of aligning measurements of learning competencies to dubious evaluations of 'intelligence', standardized as these might be (for example Wechsler Intelligence Scale assessments (Weschler, 1974)) although it is acknowledged that whereas an absolute score achieved in a test might be arbitrary, taking account of where this score falls in the wider distribution of similar results can be more meaningful. However, it might argued that such assessments generally fail to accommodate evaluations of competencies and strengths that fall outside the conventional framework of 'normal' learning capabilities - that is, in accordance with literacy-dominant education systems, which is consistent with Stanovich’s position on the limitations of intelligence-based aptitude competency assessments. However, ‘capabilities' in the context of 'special educational needs', is less than ideal as a descriptor (Norwich, 2013). The 'capability approach' has its roots in the field of welfare economics, particularly in relation to the assessment of personal well-being and advantage (Sen, 1999) where the thesis is about individuals' capabilities to function. Norwich (op cit) puts the capability approach into an educational

context by highlighting focus on diversity as a framework for human development viewed through the lens of social justice which is an interesting parallel to Cooper's thesis on diversity taken from a neurological perspective as discussed earlier (sub-section 2.1(II)). This all has considerable relevance to disability in general but particularly to disability in education where the emphasis on everyone becoming more functionally able (Hughes, 2010) is clearly aligned with the principles of inclusivity and the equal accommodation of difference, because the focus is inherently positive as opposed to dwelling on deficits, which connects well with the principles of Universal Design for Learning outlined above.

V IMPACT OF THE PROCESS OF IDENTIFICATION

Exploring the immediate emotional and affective impact that the process of evidencing and documenting a learner's study difficulties has on the individual under scrutiny is a pertinent and emerging research field. (Armstrong & Humphrey, 2008). Perhaps as an indication of an increasing awareness of the value of finding out more about how an individual with dyslexia feels about their dyslexia, studies that relate life or learning histories of individuals with dyslexia are becoming more widespread. For example, Dale and Taylor (2001) found that one group of adult dyslexic learners attending a focus group seeking feedback about a short adult learning study-skills awareness course, were citing the non-recognition of their dyslexia in earlier schooling as inherently disabling; Burden and Burdett (2007) asked 50 adolescents to construct mind-picture images of what dyslexia meant to each of them to explore the affective dimension of dyslexia. The outcome was that most described it as an insurmountable barrier - in learning contexts at least; Evans (2013) explored how student nurses constructed their dyslexic identity, finding that being made to feel stupid was linked to dyslexia both in historical learning contexts as well as in their current learning interactions. In these individuals this widely led to their dyslexia not being disclosed in their workplaces; Cameron and Billington (2015a) looked at how a small group of university students with dyslexia constructed their dyslexic identity with significant themes emerging: firstly, how these students had internalized the power of assessment grading as a marker of worth, and how they perceived this to interact with the status of their dyslexic label; secondly, about the tensions between the idea of high levels of literacy being aspirational, and acknowledging their challenges in reading, writing and spelling; and lastly, an uncertainty about whether or not dyslexia was a morally valuable label to be given. In a similar, HE context, Cameron's later (2016) study exploring the day-to-day experiences of students with dyslexia identified several consistent themes. These included challenges in translating thoughts into coherently expressed ideas, especially when presenting these to peers and lecturers where feelings of not being good enough through being not properly understood increased negative feelings of self-worth, and difficulties with not feeling welcome in academic learning spaces due to experiences of being perceived by peers as 'different'.

One intriguing study attempted to tease out meaning and understanding through the medium of social media (Thomson et al., 2015) where anonymous 'postings' to an online discussion board hosted by a dyslexia support group resulted in three, distinct categories of learning identities being established: learning-disabled, differently-enabled, and societally-disabled. It was observed from these postings that while some contributors took on a mantle of 'difference' rather than 'disability' hence expressing positivity about their dyslexia-related strengths, most appeared to be indicating more negative feelings about their dyslexia, with some suggesting that their 'disability identity' had been imposed on them (ibid, p1339) not least through societal norms for literacy. It may be through

a collective study (in the future) of others' research in this area that conclusions can be drawn relating to the immediate impact on individuals when they learn of their dyslexia. However, in the absence of any such meta-analysis being found so far, even a cursory inspection of many of the learning histories presented in studies to date generally reveals a variety of broadly negative and highly self-conscious feelings when individuals learn of their dyslexia. Although such reports are in the majority it is acknowledged that there is some evidence of positive experiences associated with learning about one's dyslexia in studies which have identified learners who claimed a sense of relief that the 'problem' has been 'diagnosed' or that an explanation has been attributed to remediate their feelings of stupidity as experienced throughout earlier schooling (e.g.: Tanner, 2009; Glazzard & Dale, 2013; Loveland-Armour, 2018). However, most examples suggest that many learners with dyslexia feel emotionally burdened or troubled by their dyslexia, and that they perceive it to be disabling in many ways, particularly so in learning spaces where feelings of differences or anxiety related to their dyslexia being ‘discovered’ may inhibit their engagement with their learning and their confidence in approaching their studies effectively.

VI To identify or not to identify - Is that the question?

Hence a dilemma arises about whether or not to (somehow) identify dyslexic learning differences. On the one hand, there is a clear and compelling argument that favours progressively changing the system of education and learning so that difference becomes increasingly irrelevant. On the other, the pragmatists argue that taking such an approach is idealistic and unachievable and that efforts should be focused on finding better and more adaptable ways to 'fix' such minority learners so that they are able to comply more effectively with existing learning-and-teaching norms. In the short term at least, the pragmatists' approach is the more likely to persist but in doing so, constructing an identification process for learning differences that attributes positivity onto the learning identity of dyslexic individuals rather than burdens them with negative perceptions of the reality of difference, would seem to be preferable.

This is important for many reasons, not the least of which is that an assessment/identification/diagnosis that focuses on deficit or makes the 'subject' feel inadequate or incompetent is likely to be problematic, however skilfully it may be disguised as a more neutral process. Despite some evidence to the contrary, this may be due to the lasting, negative perception that an identification of dyslexia often brings, commonly resulting in higher levels of anxiety, depressive symptoms, feelings of inadequacy and other negative-emotion experiences, which are widely reported (e.g.: Carroll & Iles, 2006, Ackerman et al., 2007, Snowling et al., 2007). This is especially important to consider in the design of self-report questionnaires that may form part of an assessment, where replies are likely to be more reliable if the respondents feel that the responses they provide are not necessarily portraying them poorly, particularly so in the self-reporting of sensitive information that may be adversely affected by social influences and which can impact on response honesty (Rasinski et al., 2004).

Thus it would appear that identifying dyslexia through a binary process is not especially helpful, because dyslexia is most recently being constructed as a multifactorial or multidimensional situation, as outlined above in sub-section 2.1(I) .Recall that this is where dyslexic individuals present a wide range of characteristics and attributes that reflect both skills and talents, as well as difficulties and challenges, all to varying degrees. Hence devising a process for gauging the ‘level

of dyslexia' that an individual may present can have value in an educational context, because it might encourage a better alignment of learning strategies to learning strengths whilst at the same time identifying ideas for reducing the impact of difficulties and weaknesses. This may be especially true in literacy-based learning activities where the dyslexic student, intellectually capable as they are likely to be, may still experience some challenges when engaging with an academic environment.

Gauging dyslexia as the 'severity of dyslexia' is not consistent with the stance of this current study because one of the underlying strands is to try to approach the dyslexic condition from a positive perspective. To contextualize the level of dyslexia as the *severity* of dyslexia implies the opposite, as the argument thence has tried to present, not least because to do so aligns dyslexia with the deficit/discrepancy model and worse, when dyslexia is diagnosed, alludes to it being a disabling illness which needs treatment, cognate to the now outdated medical model of disability. However, it has already been established (in sub-section 2.1(I)) that in the current climate, labelling a learner with a measurable learning challenge such as dyslexia, which, under the terms and descriptors of the Equality Act 2010, is classified as a disability (in the UK), opens access to learning support services. These are designed to scaffold the 'reasonable adjustments' and other accessibility constructs that are offered by higher institutions for compliance with disability legislation, to try to ensure equal learning opportunities for disabled students. This at least is one justification for devising mechanisms for assessing firstly whether an individual is dyslexic or not, but also for determining the extent, that is, the magnitude of influence, of the dyslexic learning differences so that the required range of learning support provisions might be established to enable this student to function more equally in the predominantly non-dyslexic learning environment of university.

VII MEASURING DYSLEXIA - "HOW 'DYSLEXIC' AM I?"

Thus it might be thought that 'measuring dyslexia' is a natural consequence of 'identifying dyslexia' and although commonly used dyslexia screening tools such as the Lucid Adult Dyslexia Screener (LADS) (Singleton & Thomas, 2002) or the Dyslexia Adult Screening Test (DAST) (Fawcett & Nicholson, 1998) offer comprehensive outputs from a range of tests and assessments, these all require interpretation. In UK universities this is usually the task of a Disability Needs Assessor and because the outputs from the tests and assessments tend to be quite 'technical', this professional interpretation forms an important part of guiding a dyslexic student towards more clearly understanding their dyslexia and how it may impact on their studies at university.

An indication of dyslexia that results from a screening is generally accompanied by a recommendation for a 'full assessment' which, in the UK at least, is conducted by an appropriately qualified and registered psychologist or specialist teacher/assessor. However, it might be argued that even such a comprehensive and possibly daunting 'examination' does not produce much of a useful *combined* measurement to describe the *extent* of the dyslexic difference identified, because the collective outputs from the batteries of assessments are generally interpreted into broad descriptors of 'mild', 'moderate' or 'severe' to indicate how dyslexic an individual is. Although these assessment tools do provide scores obtained on the tests that are commonly administered, these are generally of use only to specialist practitioners and not usually presented in a format that is very accessible to the student being assessed. For example, in this researcher's own experience of working with students with dyslexia at university, one student recounted that on receiving the

assessment indication of his dyslexic learning difference he asked *how dyslexic* he was, to be told that is was mild to moderate, leaving him none-the-wiser (respondent #9, Dykes, 2008, p95).

In addition to facilitating a route towards focused but differentiated study skills support interventions, this identifying or assessment process is an essential component for any claim to the Disabled Students' Allowance (DSA), although ironically, the assessment has to be financed by the student and is not recoverable as part of any subsequent award. This in itself may be a barrier to formal assessment, a conjecture possibly supported because it is acknowledged that university communities are likely to include a significant proportion of unidentified dyslexic students (Tops et al., 2012; Lindgren, 2012; Belger & Chelin, 2013), Thus, for those who have become aware that dyslexia might account for their academic difficulties, or may even have been told as much by tutors or perhaps their peers, the costs of an assessment to confirm dyslexia or not could deter them from undertaking one. Certainly for school-aged learners, identifying dyslexia is rooted in establishing capabilities that place them outside the 'norm' in assessments of competencies in phonological decoding and automaticity in word recognition, and in other significantly reading-based evaluations as has been broadly outlined earlier (sub-section 2.1(II)). Sometimes these include assessments of working memory such as the digit span test, which has relevance to dyslexia because working memory abilities have clear relationships with comprehension. If a reader arrives at the end of a long or complex sentence but fails to remember the words at the beginning long enough to connect with the words at the end, this is likely to compromise understanding.

All of these identifiers carry useful, quantifiable measures of assessment, although they are discretely determined, and not coalesced into an overall score or value. Nevertheless, at early-learning levels these processes have proved to be sufficient for educators to establish dyslexia in children. However, evidence suggests that identifiers used for catching the dyslexic learner at school do not scale up very effectively for use with adults (e.g.: Singleton et al., 2009). This may be especially true for the academically able learners that one might expect to encounter at university who can, either actively or not, mask their difficulties (Casale, 2015) or even feign them if they perceive advantage to be gained (Harrison et al., 2008). But recent studies continue to reinforce the idea that dyslexia is a set of quantifiable cognitive characteristics (Cameron, 2016) which extend beyond the common idea that dyslexia is mostly about poor reading, writing and spelling, certainly in the university environment. It is acknowledged that difficulties associated with compromised literacy skills can be common in university students because dyslexia in one form or another persists into adulthood (Hanley, 1997; Elbro et al., 1994; Kirby et al., 2008).

Evidence for this is especially apparent in studies that focus on the impact of phonological awareness on reading ability (Shaywitz et al., 1999; Svensson et al., 2003). It is also evident that identifying dyslexia in adults is more complicated than in children, especially in broadly well-educated adults attending university because many of the early difficulties associated with dyslexia may have receded as part of their progression into adulthood (Kemp et al., 2009; Undheim, 2009). This may have been either as a result of early support, or through self-developed strategies to overcome early-learning difficulties. Such individuals have come to be regarded as 'as compensated adult dyslexics' in some studies (e.g.: Lefly & Pennington, 1991; Brunswick et al., 1999; Miller-Shaul, 2005; Beidas et al., 2013;), at least in regard to their phonological processing

skills, and hence reading, writing and spelling abilities. The research is far from conclusive about the reasons for dyslexia compensation, so it is of significant interest to note that very recent research concerning the abilities of dyslexic university students to overcome the persistent phonological deficits which have essentially characterized the identification of their dyslexia, suggests that this may be achieved through their development of morphological knowledge in reading (Cavalli et al., 2017). In linguistics, morphology concerns the structure of words in terms of morphemes as the smallest indivisible elements of words which take or indicate meaning; for example, in 'unhappy' the 'un' indicates 'not', or in 'teacher' the 'er' indicates one who teaches. Hence morphemes are more related to meaning, whereas phonemes are related to auditory correspondences in work construction.

Many languages but particularly English, tend to be comprised of morphemes as well as phonemes and this may explain why although phonological awareness may be a good indicator of reading skills, it is not infallible because sensitivity to each of these word units might be significant in decoding abilities (Singson et al., 2000). The Cavalli et al. study revealed that in the higher-functioning adults that comprised their sample of university students (n=40) there was a significant disassociation between the development of morphological abilities and phonological ones, and that the magnitude of this disassociation correlated with reading ability (ibid). This result was in keeping with an earlier study (Martin et al., 2014) which also suggested that this development of strong morphological awareness could be a significant compensation in the development of literacy skills for dyslexic students, with both of these studies building on a body of research that is exploring which aspects of the reading ability required in university students have been compensated in those with dyslexia, and how this compensation has been executed (e.g.: Parrila & Georgiou, 2008).

What emerges from this overview, is evidence that at university, other dimensions of dyslexia aside from reading ability and phonological processing, may be more significant characteristics of many dyslexic university students' learning needs. This may be because these adults can have developed strong strategies for dealing with earlier reading weaknesses. Hence, identification and assessment processes that have literacy and decoding skills at their core, are, not so much less relevant than such tests may have been for earlier-years learners, but that other, dyslexia-inherent issues are likely to be more significant in university learning contexts.

ADULT DYSLEXIA ASSESSMENTS

The last two decades or so have seen the development of a number of assessments and screening tests that aim to identify – but not specifically measure - dyslexia in adults. This has emerged particularly in HE contexts as a response to the increasing number of students with dyslexia attending university (HESA, 2018; Dobson, 2018). An early example of a screening assessment for adults is the Dyslexia Adult Screening Test (DAST) (Nicholson & Fawcett, 1997). This is a modified version of an earlier screening tool used with school-aged learners, but which followed similar assessment principles, mostly based on literacy criteria, although the DAST does include a backward digit span test, a non-verbal reasoning test, and a posture stability test.

One limitation of the DAST to accurately identify students with dyslexia was evidenced by an appraisal suggesting inadequate validation and standardization (Harrison & Nichols, 2005) although other studies to corroborate this have not been found. Computerized screening tools have been available for some time, such as the Lucid Adult Dyslexia Screening (LADS) (Lucid Innovations, 2015), which generates a graphical report indicating that the individual is either 'at risk' or 'not at risk'. Aside from being a coarse discriminator, 'at risk' might be taken as implying that dyslexia is viewed through the lens of negative and disabling attributes. It is unclear what an identified individual is 'at risk' of, possibly suggesting that further or worsening dyslexic characteristics may develop if the condition remains unidentified or perhaps even ‘treated’?

The screening test comprises five sub-tests which measure nonverbal reasoning, verbal reasoning, word recognition, word construction and working memory (through the backward digit span test) and indicates that just the final three of these sub-tests are dyslexia-sensitive. The reasoning tests are included based on claims that to do so improves screening accuracy, and that results provide additional information 'that would be helpful in interpreting results' (ibid, p13). This appears to be attempting to provide a measure of the individual's 'intelligence' - which, in the light of Stanovich's standpoint on intelligence and dyslexia mentioned previously (see sub-section 2.1(I)), is of dubious worth, and might be an indication that the authors of the screening test believe that there is an associative relationship between intelligence and dyslexia; an idea which has been repeatedly debunked. For example, Gus and Samuelsson (1999) argued that there is no clear, causal relationship between intelligence level and decoding skills not least because intelligence is a 'fuzzy concept' which can be assessed in a wide variety of ways, and one of the findings of the Rose review (2009) was that dyslexia is unrelated to intellectual abilities.

However, there have been other attempts to create electronic, computerized screeners, particularly since desktop computer facilities have become more widely available. Worthy of mention is the QuickScan + StudyScan Suite (Pico Educational Systems, 2011) which was was developed from data collected from 2000 university students attending two HE institutions in the UK of whom 200 were known to be dyslexic (Zdzienski, 1998). This is included in the discussion here because the design rationale shares similarities with the approach adopted in this current project for the Dx Profiler whereby the aim of the screener was to produce a wide profile of skills, attributes and characteristics through a blend of assessments that took study processes, perceived strengths and weaknesses and learning style preferences as the principal foci of its self-report questionnaire. These included a range of other characteristics and attributes that are indicators of a dyslexia with these being drawn from Vinegrad's Adult Dyslexia Checklist (1994) which has also been informative in the development of the Dx Profiler in this project. As such, the QuickScan screener sets an early precedent for an evaluator that attempts to gauge dyslexia-ness as a potentially impacting element within a wider academic learning management profile, many of the aspects of which might be equally applicable to students with no indications of a conventionally-defined dyslexia, much as the data analysis outcomes of this thesis have also revealed.

The process required the screening tool, QuickScan, to be used first where 112 self-report questions were asked; these ranged from statements gauging working memory, competencies in systematic memory recall, time-management and organization, perceived competencies in reading and spelling, handedness, together with questions which were dubiously aligned with the vision-

differences theories of dyslexia such as 'do you find that your eyes tend to get tired when reading?' and other outwardly incongruous questions such as 'do you tend to hum or talk to yourself?', 'if you get angry do you often shout?' and 'when visiting somewhere for the first time, is it the atmosphere and the feel of the place that makes the greatest impression on you?'. Respondents were required to provide only a binary (yes or no) response. No Likert-style anchor point gradations were provided to enable other response selections such as 'sometimes' or 'infrequently' to be offered. The screener remains available as a desktop application and so it was reviewed. Questions are presented in a small, on-screen text box where colour combinations between text and background are selectable from a modest choice, as is font size, echoing the popularity at the time for providing accessibility tools to make the reading of on-screen text less visually stressful, although the relationship between dyslexia and visual stress had remained contentious (Singleton & Trotter, 2005). No provision is made for audio presentation of questions, for example by using a text-to-speech engine although this may be because text-to-speech applications such as TextHelp Read & Write (Texthelp Ltd, 2015) and ClaroRead (Claro Software Ltd, 2017) were at an early stage of development and not readily available at the time.

It is claimed that 15 minutes is sufficient to complete the test but on working through the screener twice with an interval of at least 6 months between the two attempts, both took me longer than 20 minutes. The questions were answered quickly without hesitations for 'thinking time'; I have no known dyslexic learning differences and would imagine that my academic experience may have fostered a better-than-average text-scanning capability together with a familiarity with the content and context of the questions in the assessment. So, it is doubtful that a student with little or no experience of such assessments would complete it in the suggested 15 minutes. The output provided at the end of the test is a cursory, summary evaluation of learning styles (mine came out as 'multisensory' both times) with some broad guidance and advice about how to make best use of that information. Also presented were indications about whether or not a need for supplementary study support had been indicated and whether specific learning difficulties consistent with dyslexia were revealed - it suggested neither for me. If the QuickScan screener reports otherwise, the intended pathway is for the StudyScan diagnostic tool to be applied. This was a much more comprehensive diagnostic process based on the American Scholastic Abilities Test for Adults (SATA - Bryant et al., 1991) comprising 17 distinct assessments including non-verbal and verbal-reasoning tests for memory, phonological competencies, visual processing, reading and writing speeds, punctuation, numerical calculations. It was expected that the complete assessment would take between two and four hours which, by any reasonable judgment, would have made it a demanding and onerous task, especially so for the very students it was attempting to identify.

An extensive critique of the QuickScan + StudyScan Suite was conducted in a three-university collaborative project (Haslam & Kiziewicz, 2001) with data collected principally from students who undertook the complete assessment process (n=126). These data were collected at just one of those universities which had a well-developed Learning Support Service and access to data from a greater number of students with dyslexia. Haslam and Kiziewicz made a number of astute conclusions about the viability of the Suite, noting logistical challenges in administering a two-stage computerized test not least due to technical issues with the hardware and software used to present them but also due to the amount of time required to complete the tests, reporting that 'some students returned several times to complete the assessment' (ibid, p15). This highlighted the

further difficulty of respondent attrition where many students who screened as likely to be strongly dyslexic in the first-stage screener failed to complete, or even to attend the second stage multi-test StudyScan profiler. One interesting feature emerged out of the classification table of correlations between the outcomes of the QuickScan screener and those of the StudyScan assessment in that exactly half of the students who were shown by the QuickScan screener as presenting 'some of the indicators' of dyslexia and who went on to take the full StudyScan assessment were subsequently shown to have profiles which were either 'not consistent with dyslexia' or 'borderline' or presented an 'inconclusive indicator'.

A similar outcome has been observed in the current study which found that a not insubstantial proportion of students who either declared no learning challenges or who declared their dyslexia presented a Dx value that also put them in an apparently 'borderline' area. There may be many explanations for this, especially as both the survey conducted by Haslam and Kiziewicz and this current project derived data from relatively small sample sizes (n=126 and n=166 respectively) which is a limitation on the generalizability of the outcomes. However, as both studies appear to have revealed a sizeable number of students who might be regarded as partly dyslexic, or just dyslexic sometimes or in particular circumstances, the idea cannot be ignored that this may be evidence of the significant difficulties that remain when designing new processes for determining whether a student presenting a particular set of study or academic learning management difficulties is actually presenting dyslexia or not. This is the point made by Elliott and Grigorenko (2014) who conclude that if a workable assessment tool is to be devised and developed, then the primary issue is establishing sensible boundary conditions above and below which dyslexia is considered to be the cause of the student's difficulties or not.

This is, of course, not least due to a) the persistent difficulty in defining dyslexia in the first place and b) the wide diversity of learning differences that may be presented. Further doubts about the viability of the QuickScan + StudyScan Suite were identified by Sanderson (2000) whose highly critical report on unspecified 'pilot studies' of the Suite identified serious flaws in both the assessment's validity and lack of evidence of reliability. Ensuring that a test for dyslexia is valid raises a multitude of issues, not least due to the wide variety of attributes and characteristics present or absent in a bewildering array of combinations but widely regarded as possible indicators of dyslexia. Sanderson also highlighted concerns over the Suite's use of the concepts of preferred learning styles as one of the data-outcome quantifiers. Principally the criticism was that adopting the idea that preferred learning styles are fixed is dubious, citing evidence from other researchers (ibid, p286: Miles, 1991; Thomson, 1999) to highlight not only the complexity and possible fluidity of an individual's learning style but also how this may be influenced by pedagogical experiences. Mortimore (2005) also indicated the need for a cautious approach to learning styles evaluations based on limited data sources, especially when these are intended to classify learners and determine teaching approaches, not only in respect of working with dyslexic learners but also more widely. Sanderson (op cit) concluded that the publication of the QuickScan + StudyScan Suite was premature and that more work was needed at a fundamental level before the Suite could be used with confidence as a dyslexia identifier.

However, this does not alter the fact that building profiles of learners that, through careful interpretation, might provide insights into ways in which they function in learning domains can be

useful provided the outcomes of the profilers are not used too deterministically. Dyslexia is clearly not a black-and-white construct and mounting evidence supports the view that categorizing students, in HE in particular, as dyslexic or not is unhelpful, possibly stigmatizing; this is especially so when dyslexia is diagnosed as a disability. Furthermore, it becomes positively discriminatory when legislation that seeks to redress apparent disadvantage might in fact, bestow academic advantage (as mentioned previously), not least through the application of 'reasonable adjustments' which are either ‘better than reasonable’ or which may threaten academic standards by adjusting assessment criteria to compensate for learning challenges (Riddell & Weedon, 2007); this is especially the case where these might be said to be due to institutional curriculum delivery arrangements rather than being attributable to the individual learner. But gaining knowledge of a dyslexia, however it may be defined, is liberating and empowering for some adult learners (as mentioned earlier in sub-section 2.1(V)) because this might at last enable them to understand why they may have found learning so challenging in the past. Navigating a path through this landscape has been one of the greatest challenges of this research project and hence, has contributed to the rationale for designing and building the specific, evaluative tool to meet the needs of this study's research questions. By adopting an approach to devising a metric that considers variances in study behaviours and learning preferences as the basis of its working parameters, the Dx Profiler is building on the emerging discourse that is grounded in non-cognitive evaluative processes. An overview account of this design and development is presented in Section 3.1(III).

Warmington et al. (2013) responded to the perception that dyslexic students present additional learning needs in university settings in comparison with earlier-years learners, also stating that as a result of the increased participation in HE in the UK more generally, there is likely to be at least a corresponding increasing in the proportion of students who present disabilities or learning differences. Warmington quotes HESA (Higher Education Statistics Agency) figures for 2006 as 3.2% of students entering HE with dyslexia, while a recent enquiry to HESA elicited data for 2013/14 which indicated students with a learning disability accounting for 4.8% of the student population overall (Greep, 2017). However, this category also accounts for 48% of students disclosing other disabilities such as visual impairments or unseen mental health conditions. Hence, HESA does not identify dyslexia specifically, although Greep stated that HESA is of the opinion that dyslexia is by far the most numerous amongst the learning disabilities accumulated into this category. This makes students with dyslexia the biggest single group of students with disabilities at university (ibid). It is also of note that the HESA data are likely to under-report the number of students with a specific learning difficulty (that is, dyslexia) because where this occurs together with other impairments or medical/disabling conditions, specific learning difficulty is not reported as a discrete category with no way of identifying the multiple impairments (ibid). At any rate, both of these data are consistent with the conclusions that the number of students with dyslexia entering university is on the rise. Given the earlier reference to dyslexia being first-time identified in a significant number of students, post-entry, it is reasonable to suppose that the actual proportion of dyslexic students at university is substantial and also include many who are unidentified. Indeed, this current study is relying on finding such *quasi*-dyslexic students in the university community.

The York Adult Assessment-Revised (YAA-R) was the focus of the Warmington et al. study which reported data from a total of 126 students, of which 20 were known to be dyslexic. The YAA-R comprises tests of reading, writing, spelling, punctuation and phonological skills that are pitched

most directly to assess the literacy-related abilities and competencies of students at university (ibid). The study concluded that the YAA-R has good discriminatory power of 80% sensitivity and 97% specificity. However, given that the focus of the tests is almost entirely on literacy-based activities, it fails to accommodate assessments of the wide range of other strengths and weaknesses often associated with a dyslexic learning profile that are outside the envelope of reading, writing and comprehension. A similar criticism might be levelled at the DAST as this largely focuses on measuring literacy-based deficits. Indeed, Chanock et al. (2010) trialled a variation of the YAA-R (adjusted in Australia to account for geographical bias in the UK version) as part of a search for a more suitable assessment tool for dyslexia than those currently available. Conclusions from the trial with 23 dyslexic students and 50 controls were reported as 'disappointing' due not “to the YAA-R's ability to differentiate between the two groups, but with the capacity to identify any individual person as dyslexic” (ibid, p42), as it failed to identify more than two-thirds of previously assessed dyslexic students. Chanock further narrates that self-reporting methods proved to be a more accurate identifier - Vinegrad's (1994) Adult Dyslexia Checklist was the instrument used for the comparison. A further criticism levelled at the YAA-R was that it was developed on the basis of data collected from students at only one HE institution, suggesting that differences between students in different institutions was an unknown and uncontrollable variable not accounted for, but which might influence the reliability and robustness of the metric.

Tamboer and Voorst (2015) developed an extensive self-report questionnaire-based assessment to screen for dyslexia in students attending Dutch universities. Divided into three sections: biographical questions, general language statements, and specific language statements, which although still retaining a strong literacy-based focus, this assessment tool does include items additional to measures of reading, writing and copying, such as speaking, dictation and listening. In the 'general language statements' section, some statements also referred to broader cognitive and study-related skills such as 'I can easily remember faces' or 'I find it difficult to write in an organised manner'. This seems to be a good attempt at developing processes to gauge a wider range of attributes that are likely to impact on learning and study capabilities in the search for an effective identifier for dyslexia in university students and is consistent with the Tamboer et al. construction of dyslexia as a multifactorial condition. This model also resonates with an earlier self-report screening assessment which, in its design, acknowledged that university students with dyslexia face challenges that are in addition to those associated with weaker literacy skills (Mortimore & Crozier, 2006). In contrast to Chanock's findings concerning the YAA-R reported above, Tamboer and Voorst's assessment battery correctly identified the 27 known dyslexic students in their research group - that is, students who had documentary evidence as such - although it is unclear how the remaining 40 students in the group of 67 who claimed to be dyslexic were identified at the pre-test stage. Despite this apparent reporting anomaly, this level of accuracy in identification is consistent with their wider review of literature, concluding that there is good evidence to support the accuracy of self-report identifiers (ibid).

The majority of current devices used in HE settings for identifying dyslexia search diagnostically for deficits in specific, cognitive capabilities and use baseline norms as comparators. These are predominantly grounded in lexical competencies. As long as the literacy-based hegemony prevails as the defining discourse in judgments of academic abilities (Collinson & Penketh, 2010) there remains only a perfunctory interest in devising alternative forms of appraisal that might take a more

wide-ranging approach to gauging academic competencies, and especially how these may be impacted by learning differences. All of the tools use a range of assessments which are built on the assumption that dyslexia is principally a phonological processing deficit that is accompanied by other impairments in cognitive functioning which collectively, are said to disable learning processes to a sufficient extent that the 'diagnosed' individual is left at a substantial disadvantage in relation to their intellectually-comparable peers. This project is interested in measuring levels of dyslexia-ness rather than identifying dyslexia as it is central to the methodological processes of this project that a metric is devised that focuses on study attributes and learning preferences rather than the cognitive characteristics conventionally regarded as deficit indicators in individuals with dyslexia. This is also consistent with the approach focus for the ABC Scale as this was devised to gauge academic confidence in terms of study actions, plans and behaviours that impact on academic study. It is not concerned with cognitive factors. It is of note that there is a small but growing recognition in university learning development services and study skills centres, noted anecdotally, that finding alternative mechanisms for identifying study needs, whether these appear to be dyslexia-related or not, is desirable, especially in the climate of widening participation currently being promoted in our universities. Although these have been driven through a need for finding improved and positively-oriented mechanisms for identifying learning differences typically observable in dyslexic students (Casale, 2015; Chanock et al., 2010; Singleton & Horne, 2009; Haslum & Kiziewicz, 2001) what appears to be emerging is that many characteristics that are being evaluated may prove more broadly useful as identification discriminators in the realm of study skills and academic learning management across complete university communities of learners. In other words, finding ways to describe dyslexia multidimensionally as opposed to discretely identifying or diagnosing it is gaining traction, and there is evidence that this is being achieved through the use of non-cognitive parameters, notably supported by evidence provided through discursive constructions of dyslexia using the everyday lived experiences of dyslexic students at university (Tanner, 2009; Cameron & Billington, 2015a; Cameron & Billington, 2015b; Cameron, 2016; MacCullagh et al., 2016) and amongst adults with dyslexia more widely (Nalavany et al., 2011; Thompson et al., 2015).

Thus, in none of the more recently developed screening tools is there mention of a criterion that establishes *how* dyslexic a dyslexic student is, other than either in coarsely-defined gradations such as 'mild', 'moderate', 'severe', or otherwise by presenting the raw score outcomes for each of a wide range of tests and assessments which are not cohesively bound into an easily-comprehensible value. Elliott and Grigorenko (2014) argue that a key problem in the development of screening tools for dyslexia is in setting a separation boundary between non-dyslexic and dyslexic individuals that is reliable, and which cuts across the range of characteristics or attributes that are common in all learners in addition to literacy-based ones, and especially for adults learners. It is widely reported that students at university, by virtue of being sufficiently academically able to progress their studies into HE, have frequently moved beyond many of the early literacy difficulties that may have been associated with their dyslexic learning differences to perform competently in many aspects of university learning (Henderson, 2015). However, the nature of study at university requires students to develop their generic skills in independent self-regulated learning and individual study capabilities, and enhance and adapt their abilities to engage with, and deal resourcefully with learning challenges generally not encountered in their learning histories (Tariq & Cochrane, 2003). Difficulties with many of these learning characteristics or 'dimensions' that may be broadly irrelevant and go un-noticed in children may only surface when these learners

make the transition into the university learning environment because learning in HE requires greater reliance on self-regulated learning behaviours in comparison to earlier, compulsory education contexts where learning is largely teacher-directed. It will be shown below (sub-section 2.2(IV) that one factor which influences the effective development of self-regulated of learning is academic confidence. Many students, whether they are dyslexic or not, struggle to deal with these new and challenging learning regimes at university (see for example: Leathwood & O'Connell, 2003; Reay et al., 2010), not least as an outcome of successful, widening participation initiatives in UK HE which have also brought substantial increases in attrition rates amongst the very students from 'non-traditional' backgrounds that have been successfully recruited (Crozier et al., 2008).

This has seen many, if not most universities develop generic study-skills and/or learning development facilities and resources to support all students in the transition from regulated to self-regulated learning with evidence for this being widespread, ranging from reports on the successes of more general social capital interventions (Schwartz et al., 2018) to initiatives that are more keenly focused, for example on targeted discipline specific areas such as enhancing maths and numeracy skills amongst engineering students (Choudhary & Malthaus, 2017). It is possible that increasing institutional awareness of duties to respond to quality assurance protocols and recently introduced measures of student satisfaction such as the TEF (Teaching Excellence Framework) has also influenced the development of academic skills provisions in universities, together with a commercial interest in keeping levels of attrition to a minimum to reduce the financial consequences of loss of student-fees and to minimize the publicity impact that attrition levels might have on future student recruitment.

But for many students, gaining an understanding of why they may be finding university increasingly difficult, perhaps more so than their friends and peers, does not happen until their second or third year when they subsequently learn of their dyslexia, most usually through referral from diligent academic staff to learning support services (e.g.: Doherty, 2015). It might be argued that these students have been the 'fortunate few' leaving others with no formally identifiable learning, or academic learning management challenges potentially unsupported. One earlier research paper established that more than 40% of students with dyslexia only have their dyslexia identified during their time at university (Singleton et al., 1999). Widening participation and alternative access arrangements for entry to university in the UK has increased the number of students from under-represented groups moving into university learning (e.g.: Mortimore, 2013), of which students with disabilities in whatever form is one, suggesting that the Singleton et al. (op cit) estimate seems likely to be if anything, lower than the true proportion of late-identified dyslexic students. This might further suggest that many progress to the end of their courses remaining in ignorance of their learning differences, and indeed it is likely that many will have gained a rewarding academic outcome in spite of them. One explanation for this late, or non-identification may be because these more, academic learning management-type dimensions of dyslexia which are components of self-regulated learning processes, are likely to have had little impact on earlier academic progress because school-aged learners are supervised and directed more closely in their learning at those stages through regulated teaching practices. At university however, the majority of learning is self-directed, with successful academic outcomes relying more heavily on the development of effective organizational and time-management skills which may not have been required in earlier learning (Jacklin et al., 2007).

Hence, because the majority of the existing dyslexia-identifying metrics appear to be weak in gauging many of the study skills and academic competencies, strengths and weaknesses of university students with dyslexia that may either co-exist with persistent literacy-based deficits, or have otherwise displaced them, this raised a concern about using any of the existing metrics *per se*. This is a concern shared by some educators working face-to-face with university students where there has been a recent surge in calls for alternative assessments which more comprehensively gauge a wider range of study attributes, preferences and characteristics (e.g.: Chanock et al., 2010; Casale, 2013). Thus for this current study it was felt that none of the existing evaluators would be able to accurately identify a dyslexic student from within a normative group of university learners - that is, students who include none previously identified as dyslexic nor any who are purporting to be dyslexic – or ascribe a measure of the dyslexia to the identification in a more finely graded way - that is, to establish a level of dyslexia-ness. Therefore, the development of a bespoke tool for gauging dyslexia-ness in its broadest context was considered necessary. The design of this needed to ensure that all students who used it felt that they were within its scope and that it would not reveal a set of study attributes that were either necessarily deficit- or disability-focused. Such tool needed to satisfy the following criteria:

- it is a self-report tool requiring no administrative supervision;
- it is not entirely focused on literacy-related evaluators, and attempts to cover the range of wider academic issues that arise through studying at university;
- it includes some elements of learning biography;
- its self-report stem items are equally applicable to dyslexic and to apparently non-dyslexic students;
- it is relatively short as it would be part of a much larger self-report questionnaire collecting data about the seven other metrics being explored in this research;
- it draws on previous self-report dyslexia identifiers which could be adapted to suit the current purpose to add prior, research-based validity to the metric;
- the results obtained from it will enable students to be identified who appear to be presenting dyslexia-like attributes but who have no previous identification of dyslexia – that is, *quasi*-dyslexic students.

The goal for this metric was to gauge a range of dimensions across a student's learning profile and attempt to quantify learning, study, and learning-biography attributes and characteristics which are known to exhibit differences between dyslexic and non-dyslexic individuals into a comparative measure. This could be used as a discriminator between students presenting a dyslexic, a *quasi*-dyslexic and a non-dyslexic profile out of two samples of university students, one group who have declared that they are dyslexic (the Control), and another who have declared no dyslexic learning differences. The metric was not intended to be an *identifier* of dyslexia as this would have raised ethical issues of disclosure. The measure is a coefficient and hence adopts no units. The tool that has been developed to generate the index value has been referred to as the Dyslexia Index Profiler, and Dyslexia Index will be frequently abbreviated to Dx. The literature review so far will have demonstrated unease with the use of the term 'dyslexia' as a descriptor of a wide range of learning and study attributes and characteristics that can be observed and objectively assessed in all learners in university settings. Notwithstanding these issues, in the interests of expediency, ‘dyslexia’ will be used throughout this study.

VIII DYSLEXIA - SUMMARY

This first sub-section has attempted to present an overview of the syndrome of dyslexia at a sufficient level of detail, and to partially provide the theoretical underpinnings of this research project. It commenced by setting out the chosen definition for dyslexia that was considered to best match the stance of this project, and continued by briefly reviewing a selection of the most important theories about what dyslexia is and what its causes may be. It has been acknowledged that dyslexia is fundamentally about the communication skills and competencies of literacy, that is, reading, writing and spelling, especially in early-years learners. But an attempt has been made to demonstrate that a wide diversity of additional characteristics or dimensions can also be associated with the situation and circumstances of dyslexia. It has been shown that in university-level learners, it is often these other dimensions which may have a more significant impact on how students engage with their studies at university and hence how this may affect their confidence in their learning capabilities – that is, their academic confidence. This is because earlier literacy difficulties have often been strategically managed or accommodated into a learning profile and identity so as to have a reduced impact on learning that remains literacy-based.

A polemic which runs through this discussion takes the position that were education and learning to have a more diverse range and scope in its curriculum delivery and assessment processes, and be less rigidly attached to literacy as a skill to be mastered so as to enable a learner to accurately demonstrate their knowledge or express their ideas, then individuals with dyslexic learning differences would be at less of a disadvantage in comparison with their peers. A shift towards the wider adoption of the ethos and principles of Universal Design for Learning has been strongly advocated, especially in HE contexts where firstly there is the scope for pedagogical processes to be more flexible and adaptable given sufficient impetus; and secondly, procedures for assessment could be more thoughtfully and less rigidly designed because they are less bound to nationally-devised outcome performance standards and indicators, endemic at lower levels of teaching and learning. By revising university teaching and learning in this way, students who present learning differences, whether dyslexic or otherwise, or alternative learning preferences or strengths that fall nearer the periphery of those considered as more typical, might be empowered to more effectively demonstrate their academic capabilities and become more confident students. The issue of academic confidence will be considered next.

2.2 Academic Confidence

I Overview

Confidence is a robust dimensional characteristic of individual differences (Stankov, 2012). It can be considered as a sub-construct of self-efficacy where this is concerned with an individual's context specific beliefs about the capability to get something done (Bandura, 1995). Students who enter HE or college with confidence in their academic abilities to perform well, *do* perform significantly better than their less-confident peers (Chemers et al., 2001) and are likely to enjoy their studies more readily (Putwain et al., 2013). Research suggests that if individuals believe that they have no power to produce results then they will not attempt to make them happen (Bandura, 1997) and specifically, when students lack confidence in their capacity to tackle academic tasks they are less likely to engage positively with them (Pajares & Schunk, 2002). Academic confidence can be thought of as a mediating variable - that is, it acts bi-directionally - between individuals' inherent abilities, their learning styles and opportunities presented in the environment of HE (Sander & Sanders, 2003) and particularly when academic confidence is fostered as part of learning community initiatives, it can be an important contributor to academic success (Allen & Bir, 2012).

Thus, confidence can be regarded as students' beliefs that attaining a successful outcome to a task is likely to be the positive reward for an investment of worthwhile effort (Moller et al., 2005). Conversely, in those for whom confidence in their academic abilities is weak, these learners can interpret the accompanying anxiety related to academic performance as a marker of their incompetence, although this may be an incorrect attribution which in turn, may lead to exactly the fear of failure that has generated the anxiety (Usher & Pajares, 2008). Perceptions of capability and motivation, which include judgements of confidence, feature significantly in self-concept theories; in particular, Social Cognitive Theory. This is where beliefs in personal efficacy are thought to be better predictors of academic outcomes than actual abilities or evidence from prior performance, because these beliefs are fundamental in establishing how learners are likely to tackle the acquisition of new knowledge and academic skills and how they will apply these productively, leading to positive and worthwhile outcomes (Pajares & Miller, 1995).

Social Cognitive Theory (SCT) enshrines these ideas and has been developed through decades of research and writing, particularly by Bandura (commencing: 1977). The underlying principle in SCT is that it is an attempt to provide explanations for the processes that drive and regulate human behaviour, according to a model of emergent interactive agency (Bandura, 1986). This is a model which attributes the causes of human behaviour to multifactorial influences derived principally from the reciprocal interactions between inherent personal characteristics, the local and wider environment that surrounds the domain of behavioural functioning, and the behaviour itself. As such, considerable interest in SCT has been expressed by educationalists and education researchers seeking to apply and integrate the ideas enshrined in the theory into a clearer understanding of the functions of teaching and learning processes, especially for making these more effective mechanisms for communicating knowledge and expressing ideas, and for interpreting the roots and causes of both academic failure and success.

Within this over-arching theory, the position of self-efficacy (and by inference, academic self-efficacy) as a social psychological construct that relates self-belief to individual actions is a central and fundamental element. Self-belief is a component of personal identity and some of the roots of Bandura's theories can be traced to earlier work on personal construct theory asserting that an individual's behaviour is a function of not only the ways in which they perceive the world around them, but more particularly how they construct their world-view in such a way that enables them to navigate a path through it (Kelly, 1955). Along this route from Kelly to Bandura can be found the Rogersian 'person-centred approach' which takes as its focus the concept of the 'actualizing tendency' – i.e. the basic human processes that enable the accomplishment of our potential by developing our capacities to achieve outcomes (Rogers, 1959). We can see the embodiment of this in HE through institutions seeking to adopt a 'student-centred' learning environment where the aim is to shift the focus from a didactic curriculum presentation to systems of knowledge delivery and enquiry which are more co-operative and student self-managed, with varying degrees of success (O'Neill & McMahon, 2005).

These underpinning arguments relating to human functioning have influenced the development of SCT by illuminating the mechanisms and processes that control and regulate the ways in which we behave and are about how human behaviour is controlled and regulated by how we think, what influences these thought processes, and how these are transformed into consequential behavioural actions. An overview of SCT will be presented next. As a bridge to the construct of academic self-efficacy and the sub-construct of academic confidence, this sub-section will continue with a brief review of the work of Zimmerman, Schunk and Pajares, whose research has been instrumental in relating SCT to educational contexts, concluding with a review of academic confidence, especially academic behavioural confidence, through the research and development work of Sander and others.

II UNDERPINNING RESEARCH PERSPECTIVES

1. AN OVERVIEW OF SOCIAL COGNITIVE THEORY

The core of Social Cognitive Theory is about explaining human behaviour in the context of systems of self-regulation. Bandura argued that these systems were the major influences that cause our actions and behaviours. Emanating from his earliest writings, the principal idea is enshrined by a model of *triadic reciprocal causation* (Figure 3) where the three interacting factors of personal influences, the environment, and action-feedback-reaction mechanisms that are integrated into all human behaviours act reciprocally and interactively as a structure that constitutes what is human agency – that is, the capacity for individuals to act independently and achieve outcomes through purposive behavioural actions. In this theory, individuals are neither entirely autonomous agents of their own behaviour nor are they solely actors in reactive actions that are driven by environmental influences (Bandura, 1989). Moreover, it is the interactions between the three factors that are thought to make a significant causal contribution to individuals' motivations and actions. These are

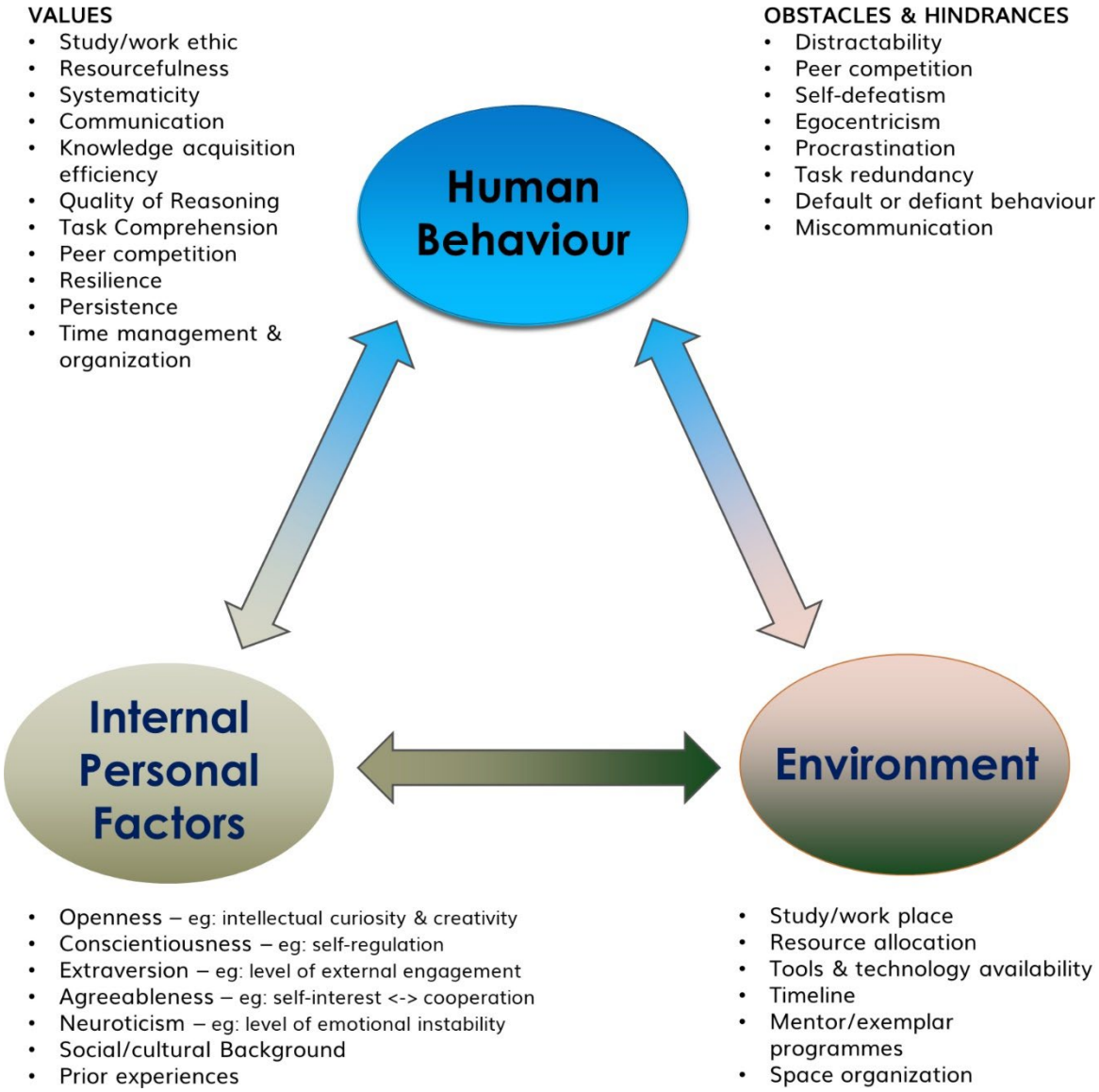


Figure 3: An adaptation of the Triadic Reciprocal Causation model.

bound up with forethought based on past experiences and other influences - many being external - that precedes purposive action. This is to say that within the context of belief-systems, goal-setting and motivation, we all plan courses of action through tasks and activities that are designed to result in outcomes. None of our actions nor behaviours are random, despite evidence in earlier theories to the contrary which appeared to have demonstrated that such random behaviours are externally

modifiable through stimuli of one form or another (e.g.: Skinner, 1953) or as more casually observed through the apparently variable and unpredictable nature of human behaviour.

By thinking about future events in the present, motivators, incentives and regulators of behaviour are developed and applied. Bandura constructs his theory of the self-regulative processes around three core concepts: that of self-observation judgmental processes, and self-reaction. Although a linearity is implied, these concepts are more likely to operate in a cyclical, feedback loop so that future behaviour draws on lessons learned from experiences gained in the past, both directly and through more circuitous processes. These are evident in self-reflective processes where, in order to influence our own motivations and actions we need to reflect on past performances.

This is especially important in learning contexts and has been established as an important guiding principle in the blend of formal and independent learning processes that constitute curriculum delivery at university, in particular, where ‘reflective cycles’ are prevalent in numerous academic disciplines. This is especially so in ones that involve an element of practice development such as nursing and teaching (e.g.: Wilson, 1996; Pelliccione & Raison, 2009). But the self-diagnostic function can be very important per se, not least because for those who are able and motivated to respond to the information acquired by reflective self-monitoring, behavioural change and/or modification of the respective environment, the potential for improving learning quality can be a valuable outcome (Lew & Schmidt, 2011, Joseph, 2009).

Being self-judgmental can be challenging, however, especially when doing so has a bearing on perceptions of personal competence and self-esteem because affective reactions (that is, ones that are characterized by emotions) that may be activated can distort self-perceptions both at the time and during later recollections of a behaviour (Bandura, 1993). But this does not alter the fact that observing one’s own pattern of behaviour is the first of a series of actions that can work towards changing it (ibid). First and foremost is making judgments about one’s own performance relative to standards. These can range from external assessment criteria to those collectively set by social and peer-group influences (Ryan, 2000) where the objective is to establish one’s personal standards with reference to the standards of the comparison group. Even within the framework of absolute standards that are set externally, social comparison has been shown to be a major factor that individuals refer to for judging their own performance, although these judgements can vary depending on which social comparison network is chosen (Bandura & Jourden, 1991). This seems likely to be highly significant in education contexts and might be taken to indicate that teacher-tutor efforts at raising the achievement standards of individual students should also be applied to the student’s immediate learning-peer-group; the outcome of this would be shared improvement throughout the group which should carry with it the desired improvement of the individual.

Performance judgements pave the way towards the last of Bandura’s three core components, that of self-reaction which is the process by which standards regulate courses of action. This is about the way in which personal standards are integrated into incentivisation or self-censure which is mostly driven by motivation levels based on accomplishment and the affective reactions to the degree to which success (or not) measures up to our internalized standards and expectations. In many domains of functioning there is abundant research to endorse the well-used cliché, ‘success breeds success’, with plenty of this in learning contexts. For example: supporting evidence has

been found in university-industry learning-experience initiatives (Santoro, 2000), in mathematics teaching and learning (Smith, 2000), or in knowledge management and more business-oriented settings (Jennex, et al., 2009; Roth et al., 1994) with these studies reporting in one form or another, the positive impact of early- or first-initiative success on later-action success.

Zimmerman (1989) reports that one of the most significant factors that differentiates between those who are successful in responding to their self-regulatory efforts and those who are not, is the effective utilization of self-incentives. We might imagine that this may be no-better illustrated than in the writing habits of PhD students who must depend on their own writing self-discipline because there is a much-reduced supervisory element at this level of study in comparison to lower degrees. Hence, developing writing incentives as part of the study-research process becomes instrumental to a successful outcome, with the most accomplished doctoral students likely to have developed the expected high-level study strategies early on. Indeed, there is now evidence to report that the process of 'blogging' as a means to provide writing incentives to university students is reaping positive benefits not least as online, personal study journals are likely to encourage extra-individual participation and self-reflection, and subsequently increase writing fluency (Zhang, 2009).

2. Self-efficacy in social cognitive theory and in learning

Based on much of his earlier work developing Social Cognitive Theory, Bandura turned his attention to the application of SCT to learning. The seminal work on self-efficacy (Bandura, 1997) has underpinned a substantial body of subsequent research in the areas of behavioural psychology and social learning theory, especially in relation to the roles that self-efficacy plays in shaping our thoughts and actions in learning environments. Self-efficacy is about the beliefs we have and the judgements we make about our personal capabilities and these are the core factors of human agency, where the power to originate actions for given purposes is the key feature (ibid, p3).

Our self-efficacy beliefs contribute to the ways in which self-regulatory mechanisms control and influence our plans and actions, and hence, the outcomes that are the results of them. Bandura's arguments about how self-efficacy impacts on effort, motivation, goal-setting, task value, task interest and task enjoyment can be usefully distilled into nine key points, additionally supported through the work of other researchers as cited. All points are highly pertinent in the domain of learning and teaching:

1. Individuals with a strong self-efficacy belief will generally attribute task failures to a lack of effort whereas those with much lower levels of self-efficacy ascribe their lack of success to a lack of ability (Collins, 1982);
2. Changes in self-efficacy beliefs have a mediating effect on the ways in which individuals offer explanations related to their motivation and performance attainments (Schunk & Gunn, 1986);
3. Self-efficacy beliefs also mediate the ways in which social comparisons impact on performance attainments (Bandura & Jourden, 1991);
4. Those who judge themselves to be more capable tend to set themselves higher goals and demonstrate greater commitment to remain focused on them (Locke & Latham, 1990);
5. Self-doubters are easily deterred from persisting towards goals by difficulties, challenges and failures (Bandura, 1991);
6. Conversely (to 5), self-assurance breeds an intensification of effort in the face of adversity or failure and brings with this, greater persistence towards success (Bandura & Cervone, 1986);

7. Self-efficacy makes a strong contribution towards the ways in which individuals ascribe *value* to the things they attempt (Bandura, 1991);
8. Individuals who present high levels of self-efficacy beliefs are more prone to remain interested in tasks or activities, especially ones from which they gain satisfaction by completing them and which enable them to master challenges (Bandura & Schunk, 1981);
9. Deep immersion in, and enjoyment of pursuits and challenges tend to be best maintained when these tasks are aligned with one's capability beliefs, especially when success contributes towards aspirations (Csikszentmihalyi, 1979, Malone, 1981);

Thus, self-efficacy is broadly about judging one's capabilities to achieve a goal and is integrated into many of the self-regulatory mechanisms that enable and facilitate the processes we need to engage in to accomplish things. That is, it is a construct that has functional characteristics and is a conduit for competencies and skills that enable positive outcomes. A function is a determinable mapping from one variable to a related dependent one, hence it is reasonable to suppose that outcome is a dependent function of self-efficacy, and that (academic) self-efficacy belief can be a dependent function of aptitude (Schunk, 1989). A typical, science student might comment, for example

> "Once I've got started on this essay about the role of mitochondria in cell energy factories, I'm confident that I can make a pretty good job of it and finish it in time for the deadline"

This student is expressing a strong measure of self-efficacy belief in relation to this essay-writing task and we should notice that self-efficacy is domain (context) specific (e.g.: Wilson et al., 2007; Jungert et al., 2014; Uitto, 2014). Task and domain specificity is considered in more detail below. For the science student, the challenges of the task have been considered and the evaluation integrated with perceived capabilities – in this case, capabilities about writing an academic essay based on scientific knowledge. Whereas outcome can be more obviously considered as a function of self-efficacy, conversely, self-efficacy belief may also be a function of outcome *expectations* because the essay writing task has not yet commenced or at least certainly is not completed. The student is projecting a belief about how successful the outcome will be for some point in the future and so it is reasonable to suppose that this may have an impact on the ways in which the task is approached and accomplished.

This is an important point, however the bidirectionality of the functional relationship between self-efficacy beliefs and outcome expectations is not altogether clear in Bandura's writings. In an early paper, it is argued that SCT offers a distinction between efficacy expectations and outcome expectancy:

> "An efficacy expectation is a judgement of one's ability to execute a certain behaviour pattern, whereas an outcome expectation is a judgement of the likely consequences such behaviour will produce" (Bandura, 1978, p240).

By including the phrase 'likely consequences', Bandura's statement appears to be indicating that a self-efficacy belief precedes an outcome expectation and although these concepts seem quite similar they are not synonymous. For example, a student who presents a strong belief in her capacity to learn a foreign language (which is self-efficacy) may nevertheless doubt her ability to succeed (an outcome expectation) because it may be that her language class is frequently upset by disruptive peers (Schunk & Pajares, 2001) and this conforms to the correct sequential process

implied in the statement above. The key idea according to Bandura and others such as Schunk and Pajares – who broadly take a similar standpoint to Bandura although acknowledge that the relationships between self-efficacy beliefs and outcome expectancy is far from straightforward – is that beliefs about the potential outcomes of a behaviour only become significant *after* the individual has formed a belief about their capability to execute the behaviour likely to be required to generate the outcomes (Shell et al., 1989).

This is suggested to be a unidirectional process – that is, it cannot occur the other way around. This is important because it implies that self-efficacy beliefs *causally* influence outcome expectancy rather than proposing a bidirectional, perhaps more associative relationship between the constructs, or that there are circumstances when they may be mutually influential. Bandura provides a useful practical analogy to argue the point that self-efficacy beliefs more generally precede outcome expectations as he says:

> "People do not judge that they will drown if they jump into deep water and then infer that they must be poor swimmers. Rather, people who judge themselves to be poor swimmers will visualize themselves drowning if they jump into deep water" (Bandura, 1997, p21).

This is also demonstrated in the conditional relationships between self-efficacy beliefs and outcome expectancies as Bandura sees them (Figure 4).

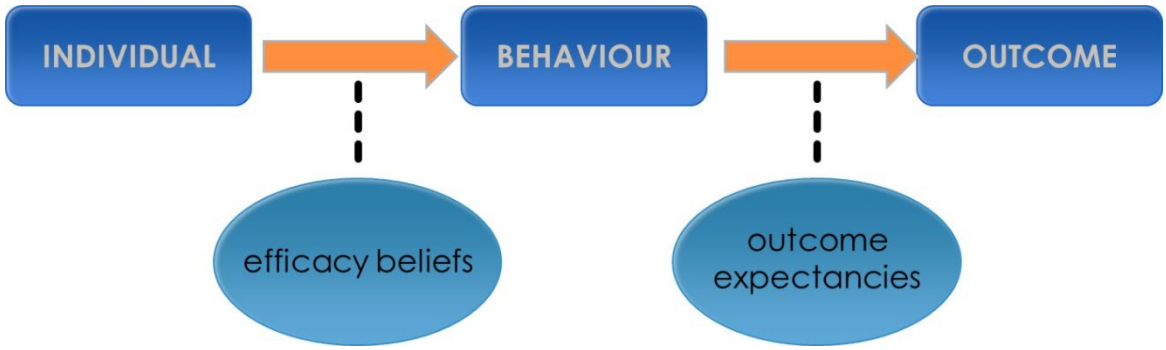


Figure 4: Conditional relationships between self-efficacy beliefs and outcome expectancies (Adapted from Bandura, 1997, p22).

However, a wider review of the literature shows that the evidence is conflicting from the start, because definitions of construct parameters are not universally agreed. In trying to establish exactly what is meant by an individual's self-efficacy beliefs, understanding is clouded because the key parameter of 'capability', widely used in research definitions, must be relative to the domain of interest but is also necessarily subjective, based on the individual's perception of their capability in that context. Thus, even in an experiment with a clearly defined outcome that seeks to discover more about participants' context-based self-efficacy beliefs and their task outcome expectancy, the variability between participating individuals' perceptions of their capabilities, even in the same context, would be difficult to control or objectively measure. This is because these are ungradable, personal attributes formed through the incorporation of a diversity of individualized factors ranging from social, peer-group and family influences (Juang & Silbereisen, 2002) to academic feedback reinforcement which can be both positive and negative (Wilson & Lizzio, 2008).

There is additional evidence from studies which appear to expose a deeper flaw in Bandura's key argument, concisely summarized by Williams (2010), who seemed unsettled by studies' blind adoption of theory as fact rather than being guided by the spirit of scientific research based on *nullius in verba*. In his paper (ibid), a case was built through the examination and citation of several examples of research which countered Bandura's 'fact' that self-efficacy beliefs causally influence outcome expectancies in that direction only. Williams summarizes an argument about the causality of self-efficacy beliefs on behaviour that has remained unresolved for three decades, particularly through use of research by Kirsch (e.g. 1992) amongst notable others, which explored the impacts that incentivizing outcome expectancy has on perceptions of capability, that is, self-efficacy beliefs. Williams re-ignited the debate on whether or not self-efficacy beliefs can be attributed as a cause for behaviour without being influenced by expectations of possible outcomes that will result from the behaviour, or even that the complete process can just as likely occur the other way around.

We are therefore left with two uncertainties when seeking to use the principles of self-efficacy beliefs to explain individuals' behaviour: the first is that operational definitions of attributes and characteristics of self-efficacy are difficult to firmly establish, particularly the notion of 'capability'; and secondly, that Bandura's underlying theory appears not quite as concrete as many researchers may have assumed. This is despite Bandura's numerous papers persistently refuting challenges (e.g.: Bandura, 1983, 1984, 1995, 2007). So it seems clear that care must be exercised in using the theory as the backbone of a study if the outcomes of the research are to be meaningfully interpreted in relation to their theoretical basis. In particular, there seems some inconsistency about the operational validity of the self-efficacy<->outcome expectancy relationship in some circumstances, notably ones that may involve attributing the functional relationships between the two constructs into phobic behaviour situations where self-efficacy measures of (cap)ability are obfuscated by the related but distinct construct of willingness (Cahill et al., 2006). Given elements of phobic behaviour observed and researched in the domain of education and learning (e.g.: school phobias; for some useful summaries see: Goldstein et al., 2003; King et al., 2001; Kearney et al., 2004), consideration of this facet of self-efficacy belief theory to learning contexts should not be neglected.

In summary, it is useful to compare the schematic above (Figure 4) which illustrates the unidirectional relationship from self-efficacy to outcome expectancies with Figure 5, modified for this research, based on a prior adaptation of Bandura's writings in the same volume (op cit), which apparently suggests that a reversed causality direction can occur.

3. Dimensions of self-efficacy - level/magnitude, strength, generality

Efficacy beliefs in the functional relationship that link self-efficacy through behaviour to outcome expectations (and sometimes reciprocally as discussed above) have been shown through a wide body of literature supporting Bandura's central tenets to be componential and we can think of the level or magnitude of self-efficacy expectations and the strength of self-efficacy expectations as the two primary dimensions. (Stajkovic, 1998). Magnitude is about task difficulty and strength is the judgment about the

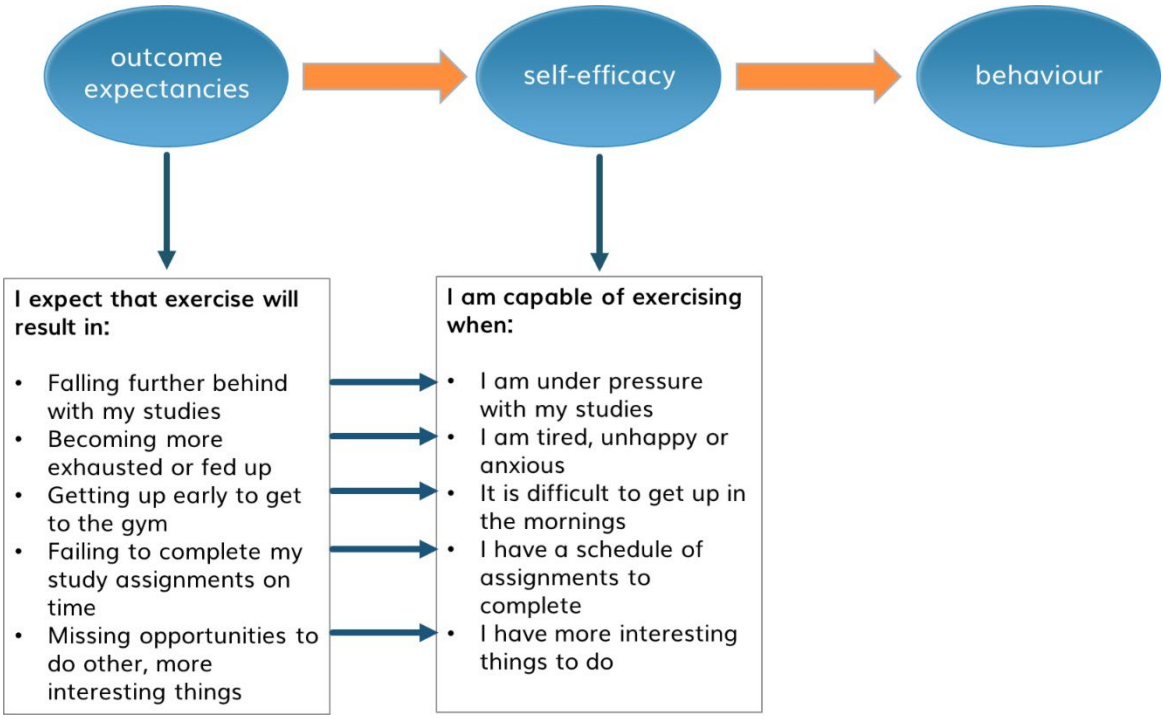


Figure 5: Illustrating a contradictory, uni-directional relationship from outcome expectancies to behaviour (adapted from Williams, 2010, p420).

magnitude: a strong self-efficacy expectation will present perseverance in the face of adversity whilst the converse, weak expectation is one that is easily questioned and especially doubted in the face of challenges that are thought of as difficult, (a sense established above in points 5 and 6). Bandura referred to *magnitude* and *level* synonymously and either term is widely found in the literature.

- MAGNITUDE: whether you believe that you are capable or not …
- STRENGTH: how certain (confident) you are …

The essay-writing example used earlier demonstrates an instance of the capacity to self-influence, and in learning challenges the ways in which an individual reacts to an academic task is suggested to be a function of the self-efficacy beliefs that regulate motivation. It also provides an example of academic goal-setting – in this case, meeting the deadline – to which motivation, as another significant self-regulator mediated by self-efficacy, is a strong impacting factor, and to which significant associations between academic goal-setting and academic performance have been demonstrated (Travers et al., 2013; Morisano & Locke, 2013). However, expanding on this is for a later discussion, although Figure 6 attempts to illustrate how the dimensions of magnitude and strength might be working in relation to the example-task of writing an academic essay. Each quadrant provides a suggestion about how a student might be thinking when approaching this task and is related in terms of their levels of perceived capability (magnitude) and confidence (strength) as dimensions of their academic self-efficacy beliefs.

In his original paper (1977)

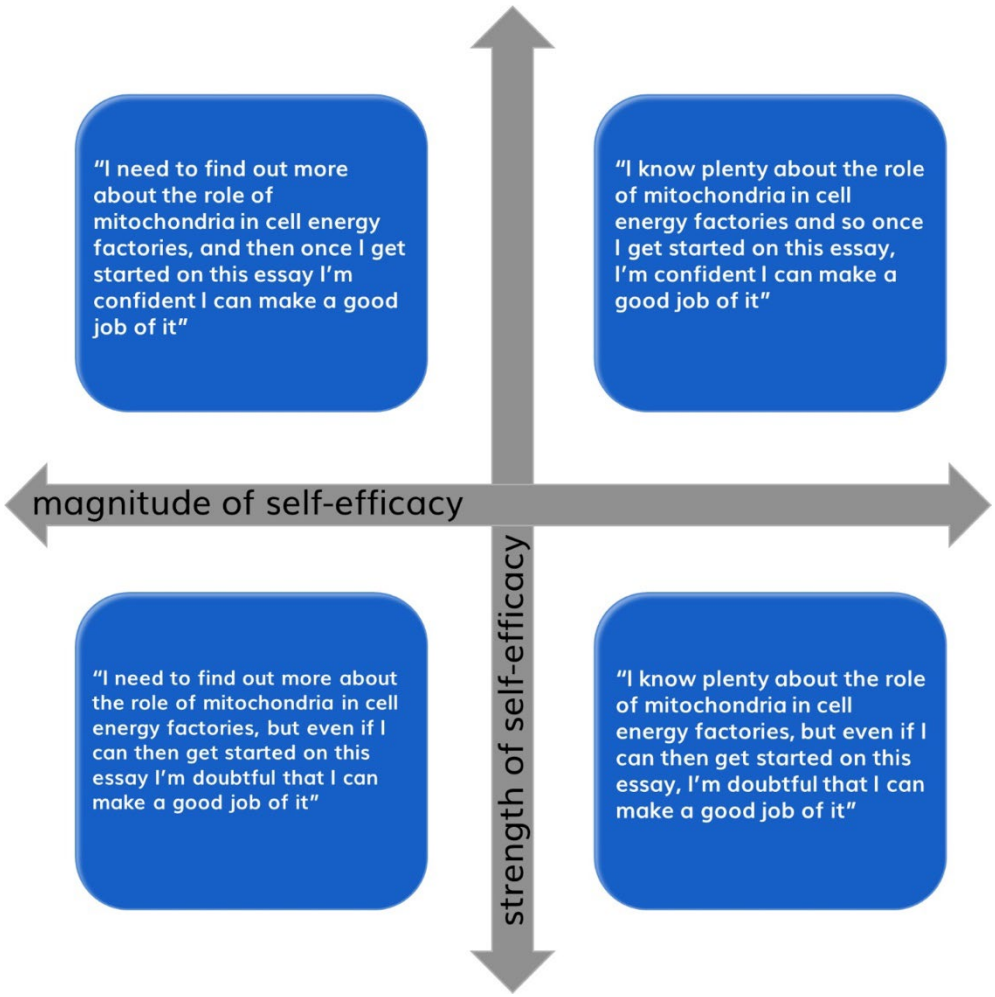


Figure 6: Illustrating magnitude and strength of self-efficacy.

Bandura set out the scope and self-efficacy dimensions of magnitude and strength, and also the third dimension, '*generality',* which relates to how self-efficacy beliefs are contextually specific or more widely attributable. The paragraph in this paper which provides a broad overview is presented verbatim (below) because it is considered useful to observe how confounding this earliest exposition is, and hence to reflect on how Bandura's original thesis may have confused subsequent researchers due to the interchangeability of terms, words and phrases that later had to be unpicked and more precisely pinned down:

> "Efficacy expectations vary on several dimensions that have important performance implications. They differ in magnitude. Thus, when tasks are ordered in level of difficulty, the efficacy expectations of different individuals may be limited to the simpler tasks, extend to moderately difficult ones, or include even the most taxing performances. Efficacy expectations also differ in generality. Some experiences create circumscribed mastery expectations. Others instil a more generalized sense of efficacy that extends well beyond the specific treatment situation. In addition, expectancies vary in strength. Weak expectations are easily extinguishable by disconfirming experiences, whereas individuals who possess strong expectations of mastery will persevere in their coping efforts despite disconfirming experiences." (Bandura, 1977, p194).

As an aside to trying to gain a clearer understanding of the message about level, strength and generality, it is of note that in this earliest of his writings on his theme, Bandura somewhat offhandedly speaks of 'expectations' which, in the light of the points made earlier, would be discomfiting were it not for later, clearer theses which relate the term to *outcomes,* with 'efficacy *expectations'* being subsequently referred to as 'perceived self-efficacy' and 'self-efficacy beliefs' – altogether more comprehensible terms. Indeed, in a later paper (1982) the phrase 'efficacy *expectations'* occurred just once and was used in referring to changes in efficacy through vicarious experiences (more of this below). By the time of this paper, Bandura's discursive focus had sharpened with the result that the ideas were less confusing for the researcher, easier to understand and more appropriately applicable.

4. TASK / DOMAIN SPECIFICITY

To follow through from the student imagined as facing a challenging essay-writing task it should be noted that self-efficacy is not necessarily a global construct and tends to be task-specific (Stakjovic, 1998). The student may think herself perfectly capable in essay-writing but consider that arguing the key points to peers through a group presentation quite beyond her. Examples from other domains as diverse as entrepreneurship (Kreuger & Dickson, 1994; Chen, et al., 1998), and journalism (Rooney & Osipow, 1992) suggest that measurable differences can be determined between generalized self-efficacy and self-efficacy related to sub-tasks within those wider domains. This indicates that there appears to be a need to distinguish between a measure that is adopted to gauge self-efficacy beliefs in a general domain to those related to specific tasks within that domain. Hence, the essay-writing student may present low self-efficacy beliefs related to the specific task of writing about the behaviour of mitochondria in cell energy factories, but be more efficacious when caused to reflect about studying more generally on her biological sciences course.

Thus, even though the wealth of research evidence supports the domain specificity of self-efficacy and indeed within that, elements of task-specificity, an element of generality may still be apparent, to the extent that some researchers have persisted in attempting to take a more generalist viewpoint on self-efficacy. For example, Schwarzer and Jerusalem (1995) developed a General Self-Efficacy Scale which attracted further development and spawned validation studies by the originators and others throughout the following two decades (e.g.: Bosscher & Smit, 1998; Chen et al., 2001; Schwarzer & Jerusalem, 2010). An example of how it has been used is demonstrated by an extensive, cross-domain and cross-cultural investigation which, through a meta-analytic validation study, claimed general self-efficacy to be a universal construct and that it could be used in conjunction with other psychological constructs meaningfully (Luszczynska et al., 2004). An even more comprehensive meta-analysis using data from over 19,000 participants living in twenty-five

countries also suggested the globality of the underlying construct (Scholz et al., 2002). Bandura has consistently doubted the veracity of research results which, he claims, misinterpret self-efficacy as a clear, narrow-in-scope construct and which hence try to justify the existence of a decontextualized global measure of self-efficacy. He especially cites the lack of predictive (for behaviour) capability that is weak when using a global measure as opposed to a specifically-constructed, domain-related evaluation, and that this 'trait' view of self-efficacy is thin on explanations about how the range of diverse, specific self-efficacies are factor-loaded and integrated into a generalized whole (Bandura, 2012, 2015).

5. Mediating processes in learning (academic) Self-Efficacy

An appealing characteristic of self-efficacy theory is that it is strongly influenced by an individual's cognitive processing of their learning experiences (Goldfried & Robins, 1982). Hence, in the field of human functioning, but especially in learning processes, Bandura's underlying arguments that efficacy beliefs are core regulators of the way we interact and engage with learning opportunities and challenges, are weighty and robust. His theories are supported by evidence that the process by which efficacy beliefs shape our learning is most strongly influenced by four, intervening agencies described as 'mediating processes', which, although may be of individual interest, are processes which operate mutually rather than in isolation (Bandura, 1997). In this context, 'mediating' means where the action of a variable or variables affect or have an impact on the processes that connect ourselves with our actions – in this case, our learning behaviour.

These four mediating processes are:

- **cognitive processes** – where efficacy, that is, the capacity or power to produce a desired effect or action, and personal beliefs in it, are significant in enhancing or undermining performance;

- **motivational processes** – where, in particular, that through integrating these with attribution theory, the focus of interest is with explaining causality. In this way, theoretical frameworks are constructed which can find reasons that set apart otherwise similarly placed individuals but who take different approaches to (learning) challenges: At one end of the spectrum is the individual who attributes success to their personal skills, expertise and capabilities, and failure principally to a lack of effort. This individual is more likely to accept the challenges of more difficult tasks and persist with them, even in the face of a lack of successful outcomes. At the other end is the individual who may be convinced that their success or failure is mainly due to circumstances outside their control and hence, generally believes there to be little point in pursuing difficult tasks where they perceive little chance of success – generating a destructive sense of learned helplessness, an attribute which is known to be associated with dyslexia (Glazzard, 2010);

- **affective processes** – which are mainly concerned with the impacts of feelings and emotions in regulating (learning) behaviour. Significantly, emotional states such as anxiety, stress and depression have been shown to be strong effectors.

- **selective processes** – where the interest is with how personal efficacy beliefs influence the types of ((social) learning) activities individuals choose to engage with and the reasons that underpin these choices.

However, the most significant aspect of SCT when applied to a social construction of learning where academic self-efficacy is suggested to be one of the most important influential factors, are the four, principal sources of efficacy beliefs. Bandura (1997) identified these four source functions as: mastery experience; vicarious experience; verbal persuasion; and physiological and affective states:

Mastery experience is about successes won by building upon positive experiences gained through tackling events or undertakings, whether these be practical or physical, theoretical or cerebral. That is, experience gained through actual performance. But building a sense of efficacy through mastery experience is not about just applying off-the-peg, 'coached' behaviours, it appears to rely on acquiring cognitive processing, behavioural and self-regulatory skills that can enable an effective course of action to be executed and self-managed throughout the duration of an activity or life-action. For example, experience gained in essay-writing at university that steadily wins better grades for the student is likely to increase beliefs of academic self-efficacy – in essay-writing at least – whereas failures will lower them, especially if these failures occur during the early stages of study and do not result from a lack of effort or extenuating external circumstances; academic self-efficacy is widely regarded as domain specific in that it must be considered as relational to the *criterial* task (Pajares, 1996). However, although successes and failures are powerful inducers, Bandura reminds us that it is the cognitive processing of feedback and diagnostic information that is the strongest affector of self-efficacy rather than the performances per se (op cit, p81). This is because many other factors affect performance, especially in academic contexts, relying on a plethora of other judgements about capability, not least perceptions of task difficulty or from revisiting an historical catalogue of past successes and failures, and so personal judgements about self-efficacy are incremental and especially, inferential (Schunk, 1991).

However, the essay-writing student will have also formed a judgement of their own capabilities in relation to others in the class. In contrast to the absolutism of an exam mark gained through an assessment process where answers are either correct or not, many academic activities are perceived as a gauge of the attainment of one individual in relation to that of similar others. The influence that this has on the individual is **vicarious experience** and it is about gaining a sense of capability formed through comparison with others engaged in the same or a similar activity. As such, a vicarious experience is an indirect one, and even though generally regarded as less influential than mastery experiences, the processing of comparative information that is the essential part of vicarious experience may still have a strong influence on efficacy beliefs, especially when learners are uncertain about their own abilities (Pajares et al., 2007). A key aspect of vicarious experience is the process of 'modelling' by which an individual externalizes the outcome of the comparative processing into actions and behaviour that are aligned with the immediate comparative peer group. Thus, for students engaging in learning activities of which they have limited experience, their efficacy beliefs can be influenced by ways in which they perceive their peers to have achieved outcomes when working on similar tasks (Hutchison et al., 2006). In a sense, this is a kind of quasi-norming process by which an individual uses social comparison inference to view the attainments of 'similar others' as a diagnostic of one's own capabilities. Hence, viewing similar others perform successfully is likely to be a factor in elevating self-efficacy, as equally the converse is likely to depress it. An element of self-persuasion acts to convince the individual that when others are able to successfully complete a task, a similar success will be their

reward too. The influence of vicarious experience has been particularly observed in studies concerning the learning behaviours of children where although 'influential adults' are of course, powerful models for signalling behaviours, when ability is a constraint, the influences induced by comparison with similar peers can be more significant (Schunk et al., 1987).

An individual's self-efficacy can also be developed as a consequence of the **verbal persuasion** of significant others who are relational to them. Verbal persuasion in the form of genuine and realistic encouragement from someone who is considered credible and convincing is likely to have a significant positive impact (Wood & Bandura, 1989). In teacher-training, the sense of teaching (self)-efficacy has been found to have a strong influence on teaching behaviour (not unsurprisingly) which is especially significant in student-teachers as they develop their classroom competencies and where encouragement gained from feedback and guidance from more experienced colleagues positively impacts on teaching practice confidence (Tschannen-Moran & Woolfolk Hoy, 2002; Oh, 2010). Additionally, in sport, there are a plethora of studies reporting the positive impact that verbal persuasion has on self-efficacy beliefs either through motivating 'team talks' presented by trainers or coaches (eg: Samson, 2014; Zagorska & Guszkowska, 2014) but also through actions of 'self-talk'. However, one interesting study reported that the greatest elevations of self-efficacy, collective efficacy and performance indicators were with individuals who practised self-talk verbal persuasion that took the group's capabilities as the focus (Son et al., 2011).

Somatic study is an enquiry that focuses individuals' awareness holistically and is inclusive of associated physical and emotional needs and where decisions are influenced and informed by an intrinsic wisdom (Eddy, 2011). If we understand 'soma' to mean in relation to the complete living body, then in the context of behavioural regulation, it means a process of *doing* and *being*. This is especially distinct from cognitive regulation of actions and decision-making – hence Eddy's attribution of somatic enquiry to dance. The connection here to Bandura's work is that in forming judgements about capabilities, individuals' **physiological and affective states** are partially relied upon and Bandura proposes that whilst somatic indicators are more especially relevant in efficacy judgements about physical accomplishments – in physical exertion such as strenuous exercise for example - our corporeal state is the most significant gauge of achievement, (or not, depending on our level of fitness perhaps). Hence it influences our predictive ability to forecast likely future capacity and potential for further improvement – the ways in which our physiology reacts to, or anticipates situation-specific circumstances and how our emotions are interrelated with this *are* impacting factors on efficacy judgements. (Bandura, 1997).

Bandura was later taken by the idea of 'mood congruency' to support the argument about how affective states are able to directly influence evaluative judgements, (1997, p112, citing Schwartz & Clore, 1988). The most important idea concerns how individuals use a perception of an emotional reaction to a task or activity rather than a recall of information about the activity itself as the mechanism through which an evaluation is formed. Hence, positive evaluations tend to be associated with 'good moods' and vice versa although it is the attribution of *meaning* to the associated affective state which can impart the greater impact on the evaluative judgement. For example, a student who is late for an exam may attribute increased heart rate and anxiety levels to their lateness rather than associate these feelings to prior concerns about performing well in the

exam – which in this case could possibly be a positive contributor to the likelihood of the student achieving a better result! Of more significance is that where mood can be induced, as opposed to being temporally inherent, a respective positive or negative impact on efficacy beliefs can also be observed, indeed the greater the intensity of mood that is evoked, the more significant the impact on efficacy becomes: individuals induced to 'feel good' exhibit more positive perceptions towards task characteristics and claimed to feel more satisfied with their task outcomes (Kraiger et al., 1989) which implies enhanced efficacy beliefs. More interesting still, is that mood inducement is reported to have a more generalized effect on efficacy beliefs rather than be directly connected with the domain of functioning at the time of the mood inducement (Kavanagh & Bower, 1985) which is clearly highly relevant in teaching and learning environments.

Contradictory evidence does exist, however, suggesting that in some situations, induced negative mood in fact increases standards for performance and judgements of performance capabilities because it lowers satisfaction with potential outcomes and hence, serves to raise standards (Cervone et al., 1994) – at least amongst the undergraduate students in that study. The argument proposed was that a consequence of negative mood was an evaluation that prospective outcomes would be lower and hence the level of performance that is judged as satisfactory, is raised, resulting in an outcome that is better than expected, suggesting the scenario of making students miserable so they try harder and hence achieve better results.

6. Agency

In more recent writing, Bandura has taken an agentic perspective to develop SCT (Bandura, 2001) in which 'agency' is the embodiment of the essential characteristics of individuals' sense of purpose. Sen (1993) argues that agency is rooted in the concept of capability, which is described as the power and freedoms that individuals possess to enjoy being who they are and to engage in actions that they value. Hence in adopting this perspective, the notion of capability becomes more crystalized as a tangible concept rather than as an elusive threshold one, as outlined above. Cross-embedded with capability is autonomy, with both being dimensions of individualism against which most indicators of agency have been shown to have strong correlations (Chirkov et al., 2003) in the field of self-determination theory (Ryan & Deci, 2000). Capability and, to a lesser extent, autonomy have been shown to be key characteristics for successful independent and self-managed learners (Lui & Hongxiu, 2009; Granic et al., 2009), especially in HE contexts where the concepts have been enshrined as guiding principles in establishing universities' aims and purpose, strongly endorsed by the Higher Education Academy some two decades ago (Stephenson, 1998). In this domain, Weaver (1982) laid down the early foundations of the 'capability approach' with strong arguments advocating the 6 Cs of capability - culture, comprehension, competence, communion, creativity, coping - that set to transform the nature and purpose of HE away from the historically-grounded didactic transmission of knowledge to largely passive recipients through a kind of osmotic process, into the kind of interactive, student-centred university learning broadly observed throughout tertiary education today. Capable learners are creative as well as competent, they are adept at meta-learning, have high levels of self-efficacy and can adapt their capabilities to suit the familiar, varied or even unfamiliar activities, situations and circumstances in which they find themselves (Nagarajan & Prabhu, 2015).

Figure 7 draws from Bandura's extensive writings to summarize the components and factors which

enable individuals' self-efficacy beliefs to move them towards a behavioural outcome. It can be seen that the picture is far from straightforward, but it shows that self-efficacy beliefs and performance as an accomplishment can be considered as precursors to outcome expectancies and outcomes themselves. In the mix are control and agency beliefs, but of particular interest is the extent to which confidence might be considered as a strong agentic factor in the flow from self-efficacy and performance towards outcomes, especially in the light of evidence that this process is not as unidirectional as Bandura would have us believe. Nevertheless, Nicholson et al. (2013) suggested that confidence, in tandem with 'realistic expectations', were key drivers that can influence academic outcomes. Findings from their study supported their expectation at the outset that more confident students would achieve higher end-of-semester marks (ibid, p12), a point made at the start of this thesis.

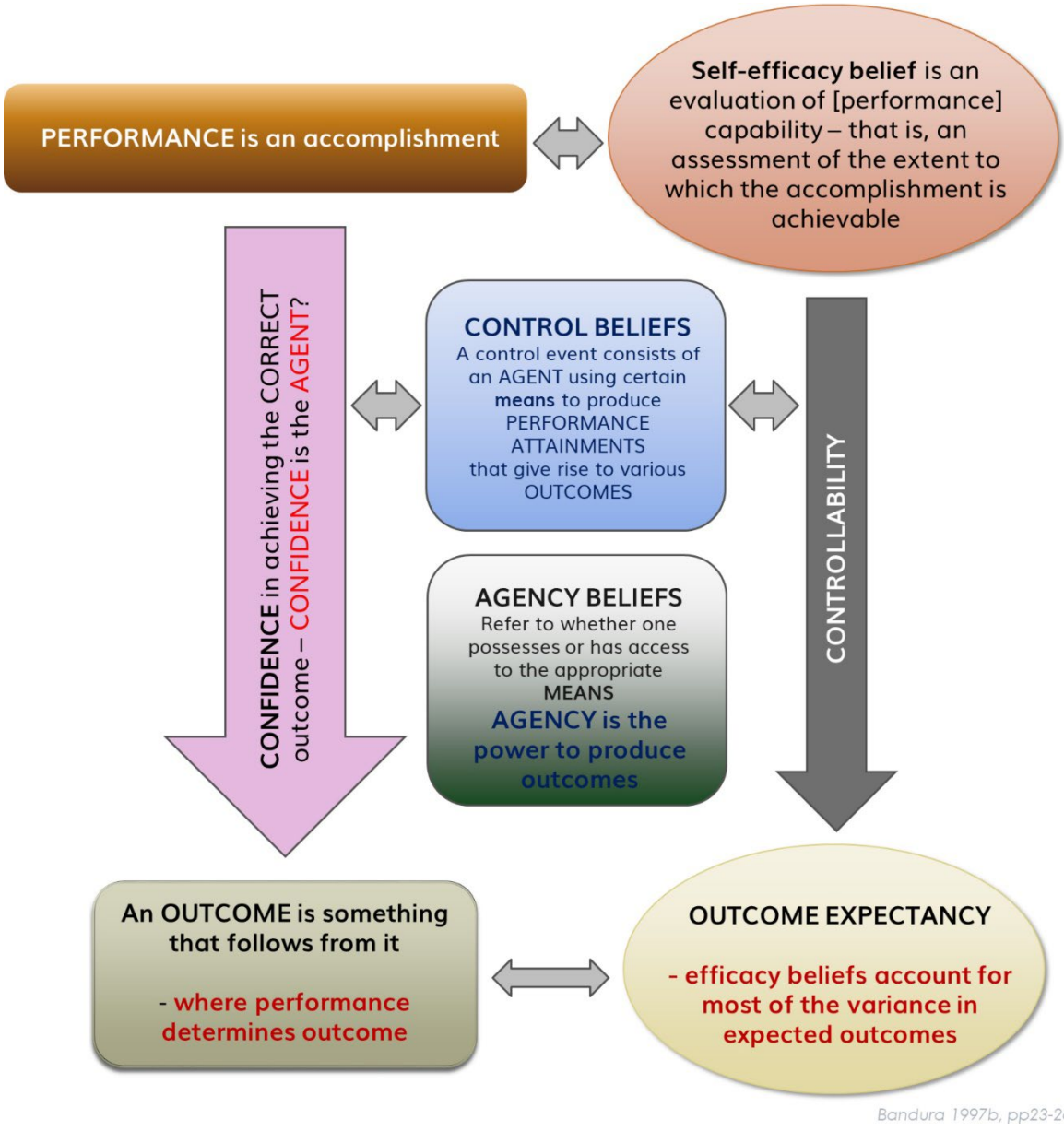


Figure 7: Summary of components and factors leading from self-efficacy beliefs to outcome expectancy (summarised from Bandura, 1997a, p23-26).

III Social Cognitive Theory in Education and Learning

The application of SCT in the domain of education and learning has attracted a substantial body of research amongst educational psychologists, theorists and research-practitioners. Their interest has been in exploring self-efficacy beliefs as one type of motivational process in academic settings not least because motivation in learning has been widely accepted as one of the major contributing factors to academic achievement (e.g.: Pintrich, 2003; Harackiewicz & Linnenbrook, 2005).

Studies include for example, exploring motivation and academic achievement in maths in Nigerian secondary school students (Tella, 2007), achievement motivation and academic success of Dutch psychology students at university (Busato et al., 2000), motivation orientations, academic achievement and career goals of music undergraduates (Schmidt et al., 2006), academic motivation and academic achievement in non-specific curriculum specializations amongst Iranian undergraduates (Amrai et al., 2011) and in a substantial cohort (n = 5805) of American undergraduates (Mega et al., 2014). All these studies indicated positive correlations between academic achievement and motivation although it was also found that motivation in academic contexts can be a multidimensional attribute, succinctly observed by Green et al. (2006) in their extensive longitudinal study of secondary students (n = 4000) in Australia.

Zimmerman has also made a significant contribution to this discourse, emphasizing the idea of self-regulated learning as a central force that can drive academic achievement. Results have demonstrated that students who are efficient at setting themselves specific and proximal goals tend to gain higher academic rewards when compared with other, less self-regulated peers (Zimmerman, 2002). Hence becoming more self-aware as a learner is agentic in developing learning effectiveness (Zimmerman, 2001).

In reviewing the literature more carefully, three features of Zimmerman's research interests emerge that are significant. Firstly, both his own, and his meta-analyses of others' studies, generally focus on finding out more about whether learners display the specific attributes of initiative, perseverance and adaptability in their learning strategies and explore how *proactive* learning qualities are driven by strong motivational beliefs and feelings as well as metacognitive strategies (Zimmerman & Schunk, 2007); Secondly, a 'soft' conclusion is reached arguing that skills and strategies associated with self-regulated learning had to be taught to students in order for them to subsequently gain academic advantages and that such strategies were seldom observed as spontaneous or intrinsically derived (e.g.: Pressley & McCormick, 1995). This is interesting because it appears to support the approach adopted in UK HE institutions that academic 'coaching' is likely to enhance academic achievement and, anecdotally at least, this coaching appears ubiquitous throughout universities who enrol learners from a range of backgrounds with an equally diverse portfolio of academic credentials. What is not clear without deeper evaluation of the relevant literature, is whether academic coaching is a remedial activity focused on bringing 'strugglers' or those deemed as ‘learning disabled’ up to the required standard. Or conversely, in being repackaged as learning development or academic enhancement, coaching services are being more widely taken up by a much broader range of learners from the student community, or even whether the more general academic portfolio that learners are bringing to university is not a match for the challenges of the curriculum and hence demands learner upskilling.

Another interpretation may be that as a result of recent government initiatives ostensibly to drive academic standards upwards through hierarchical university grading systems such as the Research Excellence Framework and the Teaching Excellence Framework (Johnes, 2016), it is in the business interests of universities to maximize the visibility of their academic 'standing' so that this can be used as a student recruitment initiative. In such circumstances, it might be argued that fostering a learning climate based on curiosity and inquisitiveness has been superseded by a need to ensure financial viability, even survival, in an uncertain economic climate in HE, and that the desire to attract students has led to a lowering of academic standards and an element of 'grade inflation' (Bachan, 2017)

The final observation is that in Zimmerman's and others' interest in developing devices to evaluate elements of self-regulated learning, these evaluative processes all seem to regard self-regulated learning as a global (learning) attribute and do not appear to have considered any domain specificity that may need to be accounted for. In other words, the assumption is that students' study strategies are likely to be consistent across all their subject disciplines and no account is taken of differences that may be measurable in their approaches to say, maths or sciences in contrast to humanities. This is all the more interesting given the American roots of both Zimmerman's research and the evaluative processes that his studies have contributed to because the curriculum in US tertiary education tends to be broader than that in the UK at least, and so we might have expected that the opportunity to explore curriculum differences in self-regulated learning would have been exploited.

Building on earlier research about links between levels of achievement in academics and in sport (Jonker et al., 2009), McCardle et al. (2017) studied competitive pre-university athletes and found that those presenting high engagement metacognitive processes and variables in their sports were also highly engaged in their academic studies. As demonstrated above, this highlights the important point that within the umbrella of SCT, under which self-regulated learning resides, the co-associated construct of self-efficacy beliefs has been shown to be less general but more domain specific in not only learning contexts but in other areas of human functioning too. This example of self-regulation in sport may be an indication that high-engagement, self-efficacy beliefs can be a transferable learning approach. This is in keeping with the construct of academic confidence, considered as closely related to self-efficacy, but which appears to present as a more generalized learning attribute, with variances across disciplines, academic or otherwise, being less observable (Sander & Sanders, 2009).

It is also worth mentioning Schunk's contributions to research about the application of SCT to educational domains, particularly to learning more about the effects of social and learning-and-teaching variables on self-regulated learning, with a particular emphasis on academic motivation, framed through the lens of Bandura's theories of self-efficacy (Schunk, 1991). In this early paper (ibid), goal-setting is said to be a key process that affects motivation, and in learning contexts Schunk suggests that close-to-the-moment or 'proximal' learning objectives tend to elicit stronger motivational behaviours in children in comparison to more distant goals, an argument that is supported by a brief meta-analysis of other studies. In young learners at least, Schunk finds that elevated motivation towards proximal learning goals is observed because students are able to make more realistic judgments of their progress towards these, whereas distant objectives by their

very nature require a much more 'regulated' approach - hence the interest and connection with self-regulated learning.

Schunk also indicates that a significant difference in levels of motivation can be observed between target goals that are specific rather than general. For example, this might be where an assessment requires a student to achieve a minimum mark in comparison to where a more general instruction to 'do as well as you can is provided as the target (ibid, p213). These are conclusions that are also evidenced in earlier studies: for example, in their meta-analysis of research of the previous two decades, Locke et al. (1981) found that in 90% of the studies they considered, higher motivational levels of behaviour and subsequent performance were demonstrated towards specific goals when compared with targets that were easy to achieve, or learners were instructed to 'do your best', or no goals were set at all.

Schunk also showed interest in the social origins of self-regulative behaviours in learning contexts through an interesting study which considered self-regulation from a social cognitive perspective. It was noted that through this lens, it can be shown that students' academic competencies tend to develop firstly from social sources of academic skill. This idea draws on earlier and much vaunted sociocultural learning theory, typically attributed to Vygotsky's thesis about the zone of proximal development, which is where learners are said to develop academic capabilities through supportive associations with their peers as much as through a teacher. Academic competency acquisition then can be shown to progress through the four stages of observational, imitative, self-controlled and finally self-regulated learning (Schunk & Zimmerman, 1997). The authors recommended that further research should be conducted, not least into how peer-assisted learning strategies might be established in learning environments and we have witnessed the legacy of this idea in universities where many such initiatives have been established in recent years. Advocates of such programmes cite studies which support their benefits in terms of improved grades and skills development (e.g.: Capstick et al., 2004; Hammond et al., 2010; Longfellow et al., 2008). This has been especially true in medicine and clinical skills education where a development of peer-assisted learning, that of problem-based learning (PBL), actively generates learning through collaborative student learning enterprises.

Finally, it is pertinent to include a brief overview of the substantial contribution to SCT in education made by Pajares. His early research explored 'teacher thinking' and in particular, how teachers' beliefs about their work, their students, their subject knowledge, their roles and responsibilities could each or all impact on educational processes, not least the learning quality of their students. The core point to be drawn was that teachers' beliefs should become an important focus for educational enquiry, so as to contribute more fully towards understanding learning processes and engagement with education (Pajares, 1992). This early line of research was supplanted with a deeper interest in self-efficacy beliefs and especially how these related to mathematical problem-solving in adolescents.

A useful paper tried to establish key differences between math self-efficacy and self-concept, finding that self-efficacy was a better predictor for problem-solving capabilities than other constructs, notably prior experience of maths, and gender, in addition to math self-concept (Pajares & Miller, 1994). Other papers exploring the relationships between maths self-efficacy beliefs and

performance predictors showed support for Bandura's contention that due to the task-specific nature of self-efficacy, measures of self-efficacy should be closely focused on the criterial task being explored and the domain of function being analysed (Pajares & Miller, 1995). It is in these and other, related papers not only with a mathematics focus but also exploring the influences of self-efficacy beliefs on student writing, (e.g.: Pajares, 1996b, Pajares & Kranzler, 1995, Pajares & Johnson, 1995) that we see Bandura's self-efficacy theories enshrined and used to underpin much of Pajares' writing, not least drawn together in an important summary paper that sought to more generally apply Bandura's ideas to educational, academic settings (Pajares, 1996a) which also acted as a prequel for Pajares' deeper interest in the developing idea of academic self-efficacy.

Work of a slightly later period focused on maths self-efficacy in US undergraduates. For example, one study conducted a review of a previously developed Maths Self-Efficacy Scale (MSES - Hackett & Betz 1982) which is of interest to this project because it applied factor analysis to the scale's results when used with a sizable cohort of undergraduates (n = 522) (Kranzler & Pajares, 1997). Although the MSES had become a widely used and trusted psychometric assessment for establishing the interrelationships between maths self-efficacy and, for example, maths problem-solving, Kranzler and Pajares argued that looking at the factor structure of the scale is an essential process for gaining an understanding of the sources of variance which account for individual differences, claiming that this is required to substantiate results. The point is that through this statistical procedure, Pajares and collaborators have shown a clear understanding of the multidimensional aspects of, in this case, maths self-efficacy but also the pertinence and value of factor analysis being applied to local study-captured data. It was also interesting to note that for this study at least, Kranzler and Pajares' analysis led to their claim for the identification of a general measure of self-efficacy which is at variance with Bandura's contention that self-efficacy beliefs are quite clearly context-specific (Bandura, 1997). It is also at variance with one of Pajares' own earlier studies (Pajares & Miller, 1995) which argued for context specificity if research outcomes are to be considered reliable and valid. It is of note that in that study (ibid, 1995), the cohort of 391 undergraduate students' self-efficacy judgement were assessed according to three criteria: confidence to solve mathematical problems, confidence to succeed in math-related courses, and confidence to perform math-related tasks. Sanders' later (2006) contention is that (academic) confidence is a sub-construct of (academic) self-efficacy and although similar, the differentiation is necessary, and so we are left to consider that Pajares and Miller's study was in fact assessing maths self-confidence rather than maths self-efficacy albeit on the basis that this small but important distinction was yet to emerge. Key to this summary of Pajares' research output and contribution to self-efficacy theory in educational settings is more recent research and summary papers which sharpen his area of interest into the emerging field of academic self-efficacy (e.g.: Pajares & Schunk, 2002). It is this sub-construct of self-efficacy that is the umbrella construct for academic confidence, operationalized as Academic Behavioural Confidence, as the dependent variable to which connections will be established with dyslexia so not to lose focus on one of the key objectives of the project: to establish that the process of identifying dyslexia in whatever form we may choose to define it in HE contexts will impact on the academic confidence of students at university thus labelled.

IV Academic Behavioural Confidence

Academic Behavioural Confidence (ABC) is the key metric being used as the dependent variable in the data analysis for this research study. Measures obtained through the application of the ABC Scale to the three, research subgroups in this study are interesting because outcomes derived from the analysis may be suggesting that identifying dyslexia has a negative impact on academic confidence and hence possibly on academic achievement, even though no research evidence o date shows that absolute scores of ABC are directly linked to absolute academic outcomes such as degree classification or grade point averages. It is suggested that a study to directly explore this possible use of ABC as a predictor of academic outcome is overdue, especially amongst groups of students conventionally considered as being under-represented at university. However, it is considered that this study offers a valuable contribution to the field of research, especially since it will be reported later that the comparison of ABC values between the three research subgroups in this project clearly demonstrates that for this research datapool at least, the ABC of students with dyslexia is not only statistically lower than for non-dyslexic students, but also lower than for students with unreported dyslexia-like profiles.

1. Historical development of the Academic Behavioural Confidence Scale

In her doctoral dissertation, Decandia (2014) looked at relationships between academic identity and academic achievement in low-income urban adolescents in the USA. Although briefly reporting on the original Academic Confidence Scale developed by Sander and Sanders in 2003, her study used neither that metric, nor the more recently developed version – the Academic Behavioural Confidence Scale – but instead, an Academic Confidence Scale originating in a near-twenty-year-old doctoral thesis (McCue-Herlihy, 1997), which Decandia developed as “an organic measure of confidence in academic abilities” (op cit, p44). This earlier thesis does not appear to have been published and thus remains lodged in its home-university repository. However, it would be of interest, as McCue-Herlihy’s Academic Confidence Scale appears to be the first time such a metric was constructed. It is assumed that it was created to contribute to gauging how the elements self-efficacy, academic achievement, resource utilization and persistence might be interrelated in a group of non-traditional college students. Hence McCue-Herlihy's work, presumably suggesting a measurable connection between confidence and routes towards achievement in academic study, appears to have pre-dated Sander's development of the Academic Confidence Scale.

Sander's scale was designed and used to explain the differences in students’ expectations of the teaching-and-learning environment of university (Sander et al., 2000). The research group in this first study consisted of medical students (n=167), business studies students (n=109) and psychology students (n=59), each studying at a different university. Aside from results and discussion that were specifically pertinent to this study, the construct of academic confidence was proposed as a possible explanation for significant differences in groups’ preferences in relation to role-play exercises and peer-group presentations as approaches for delivering the respective curricula. In particular, the medical students and the psychology students both expressed strong negativity about these teaching approaches, but it was the difference in reasons given that prompted interest: the medical students argued that neither of these teaching approaches were likely to be effective, whereas the psychology students attributed their views about the ineffectiveness of both approaches more to their own lack of competence in participating in them. Sander et al. suggested that these differences may have arisen from students' levels of academic confidence, possibly arising out of the different academic entry profiles of the two groups.

The idea of academic confidence was developed into a metric, the Academic Confidence Scale (ACS - Sander & Sanders, 2003), where academic confidence was conceptualized as the extent to which university students express strong belief or sure expectation about what the university learning experience will offer them. Hence academic confidence is a less domain-specific construct than academic self-efficacy and Sander's rationale for developing a distinct metric for exploring academic confidence had been a consequence of practitioner observations about how university teaching regimes and artefacts appear to influence student learning behaviours. This is significant for the researcher as it means that the metric can be used to explore attitudes and feelings towards study at university without these being in relation to a particular academic discipline or a specific academic competency – for example, dealing with statistics or writing a good essay.

Underpinning academic confidence as a sub-construct of academic self-efficacy, this later study set out to explore the extent to which academic confidence might interact with learning styles and impact on academic achievement. Sander and Sanders argue that academic confidence is a "mediating variable between an individual's inherent abilities, their learning styles and the opportunities afforded by the academic environment of HE" (ibid, p4). For that investigation, two further groups of medical and psychology students were recruited (n=182, n=102 respectively) although rather than attempt to relate their evaluation of the students' academic confidence to particular teaching artefacts or learning interventions, the aim of this research was to explore changes in academic confidence between two time-points, presumably to gain an insight into the impact that the university teaching and learning environment had on their levels of academic confidence although this was not a clearly stated aim.

Findings revealed that academic confidence was moderated by academic performance rather than acting as a predictor, and for these students at least, their studies appeared to have commenced with unrealistic expectations about their academic performance and this was tempered by actual academic assessment outcomes. However, as a result of this study, construct validity was established for the ACS and a preliminary factor analysis was conducted although differences between the factor loadings for the two student groups led the researchers to conclude that analysis on a factor-by-factor basis would be inappropriate in that study, although as we will see, the process of dimensional reduction was returned to later.

Research interest in the Academic Confidence Scale in this early period was modest. Of the 18 studies found, these included an exploration of music preferences amongst adolescents, relating these to personality dimensions and developmental issues (Schwartz & Fouts, 2003), to a study exploring university students' differences in attitudes towards online learning using the Academic Confidence Scale in a longitudinal survey to gauge student engagement with an online health psychology module before and after the module was completed (Upton & Adams, 2005).

Lockhart's (2004) study explored attrition amongst university students and was the first to explore the phenomenon using a sample of student drop-outs, matched with students remaining at, and students who had left university. The Academic Confidence Scale was used to explore how different levels of confidence were related to student expectations of HE. One of the findings determined academic confidence to be a significant contributor to attrition although it was acknowledged that many other factors also had a strong influence on students' likelihood of leaving

university study early. Lockhart's results also appeared to indicate academic confidence to be a transitory characteristic which is affected by the most recent academic attainments. This is consistent with the idea of academic confidence as a malleable characteristic, suggested earlier through Sander's original research and more strongly proposed in a later, summary paper (Sander et al., 2006a).

In a study similar to Lockhart's, also into student retention and likelihood of course change, Duncan, (2006) integrated five items from the Academic Confidence Scale into the research questionnaire to explore the mediating effect of academic confidence on the relationship between academic ability and academic integration, although no reasons for identifying these specific items from the full ACS as being particularly appropriate were offered. It is possible that the reason was simple expediency for reducing the questionnaire to a manageable size even though it still comprised 151 scale items. Results indicated low academic confidence to be strongly correlated with course-change or drop-out intention.

Of the remaining studies that included or implied use of the Academic Confidence Scale, all were either conducted by Sander, usually with colleagues, or Sander appears to have been a contributing author. This collection of studies includes Sander's own doctoral thesis (Sander, 2004) which explored the connections between academic confidence and student expectations of their university learning experience and built on the original project for which the Academic Confidence Scale was developed. The thesis comprised the author's prior, published works which were all concerned with exploring students' expectations and preferences towards teaching, learning and assessment at university. These early studies increased research assurances about the use of academic confidence to explain differences in students' learning preferences with the findings providing evidence that teaching institutions should attempt to gain a greater understanding of their students as learners in order for their teaching regimes, artefacts and processes of curriculum delivery to be more effective (Sander, 2005a, Sander, 2005b). This was pertinent in the university climate of a decade or so ago when student numbers increased to record levels through a variety of initiatives, not least the emergence of widening participation as a social learning construct in education and the greater diversity of students that this and other new routes into HE through foundation and access courses was bringing to the university community. An apparent consequence of this however, appeared to be greater attrition rates (e.g.: Fitzgibbon & Prior, 2003; Simpson, 2005) leading to research attention being directed towards finding explanations for increasingly poor student retention with academic confidence being linked to students terminating their courses.

The scale was renamed the Academic Behavioural Confidence (ABC) Scale to recognize that it is more properly a gauge of confidence in actions and plans in relation to academic study behaviour (Sander & Sanders, 2006b), but in all other respects the metric was unchanged. Later studies using the ABC Scale augmented the theory that academic confidence is a sub-construct of academic self-efficacy, arguing that the ABC Scale bridges the gap between self-efficacy and self-concept measures (Sander, 2006). As with earlier studies, the research was exploring ways to improve university teaching by understanding more about students' attitudes towards teaching processes commonly used to deliver the curriculum. For example, findings revealed significant differences in post-presentation academic confidence which were attributed to whether the

presentations were assessed or not assessed, with measurable gains in ABC being recorded following presentations that were assessed. Of particular interest in the discussion was an item-by-item analysis of ABC Scale statements enabling a better understanding of participant responses to be gained. This indicates that although ABC is designed to be a global measure of academic confidence, by exploring specificity, as revealed by comparisons taken from items within the scale, this can reveal detailed academic confidence profiles. Conclusions suggested that where self-efficacy measures stress the significance of mastery experience as a major part of the establishment and maintenance of efficacy beliefs - hence drawing on the underlying themes of Bandura's Social Cognitive Theory - these may not take a sufficient account of the wider socio-educational components in university study that affect students' concepts of themselves as learners, whereas the sub-construct of academic confidence is more able to do this.

Arguing that females generally lack academic confidence and that males are more likely to rate their academic abilities more highly than female students, subsequent studies used the ABC Scale to explore gender differences in student attitudes towards the academic and the non-academic aspects of university life (Sander & Sanders, 2006b; Sander & Sanders, 2007; Sanders et al., 2009). Although these studies' findings indicated little significant difference between ABC scores of males and females overall, detail differences on an item-by-item basis did emerge. For example, it was shown that male students were significantly less likely to prepare for tutorials and also less likely to make the most of studying at university in comparison to their female peers, especially in the first year of study. Although this was initially explained as possibly revealing a measure of over-confidence in males' expectation of academic achievement, it was noted that this perception was not displaced later, as actual academic achievement was comparable overall to that achieved by females, suggesting that males saw themselves as able to achieve as good a result as females but with less work, with poorer organization and less engagement with teaching sessions.

These findings demonstrate the value of examining ABC Scale outcomes in detail in addition to drawing conclusions based on overall scores. This appears to have prompted a deeper interest in the *structure* of the ABC Scale. A later study used factor analysis (Principal Component Analysis (PCA)) to search for subscales in the main scale (Sander & Sanders, 2009) with the claim that were these revealed, this may lead to a more satisfying explanation of unexpected lack of differences in academic confidence when examining the between-groups scores in earlier studies. This process had been applied to data in earlier studies, resulting in six subscales being suggested: Grades, Studying, Verbalizing, Attendance, Understanding, and Requesting. Out of the later application of PCA to the combined datasets from their previous studies (n_{total}=865) the same six subscales initially emerged, although through further, structural equation modelling, a revised, four-factor structure which more accurately reflected the most likely nature of the complete ABC Scale was suggested. These were designated: Grades, Verbalizing, Studying, and Attendance, and following further analysis exploring scale-item redundancy, the original 24-item scale was reduced to 17 items, a reduction which was later validated with a substantial sample of university students (n=2065) (Sander et al., 2011). The findings from that research were used to suggest that the ABC Scale can be helpful in gaining an understanding of students' orientation to their studies, notably as a diagnostic tool to aid tutors in creating more effective learning opportunities.

Meanwhile, other studies using the ABC Scale were beginning to emerge, possibly as a result of more widespread interest in a paper presented Sander and Sanders, (2006a) which drew useful comparisons between attributes of the related constructs of academic self-concept, academic self-efficacy and ABC (Table 1), grounded in theories of academic motivation (Bong & Skaalvik, 2003).

Comparison dimension	Academic self-concept	Academic self-efficacy	Academic Behavioural Confidence
Working definition	Knowledge and perceptions about oneself in achievement situations	Convictions for successfully performing given academic tasks at designated levels	Confidence in ability to engage in behaviour that might be required during a (student) academic career.
Central element	Perceived competence	Perceived confidence	Confidence in abilities
Composition	Cognitive and affective appraisal of self	Cognitive appraisal of self	Assessment of potential behavioural repertoire
Nature of competence evaluation	Normative and ipsative	Goal-referenced and normative	Response to situational demands
Judgement specificity	Domain specific	Domain specific and context specific	Domain and narrowly context specific
Dimensionality	Multidimensional	Multidimensional	Multidimensional
Structure	Hierarchical	Loosely hierarchical	Flat and summative
Time orientation	Past-oriented	Future-oriented	Future-oriented
Temporal stability	Stable	Malleable	Malleable
Predictive outcomes	Motivation, emotion and performance	Motivation, emotion, cognition and self-regulatory processes and performance	Motivation, coping, help-seeking and performance
(Sander & Sanders, 2006a, Table 1, p36; adapted from Bong & Skaalvik, 2003)			

Table 1: Dimensions and components of academic self-concept, academic self-efficacy and Academic Behavioural Confidence.

This comparison of dimensions demonstrates a cascade relationship between academic self-concept, academic self-efficacy and academic behavioural confidence. For example, where academic self-concept can be thought of as how an individual holds self-knowledge and self-perceptions in broad, academic outcome-driven situations, such as studying at university - within this will be held beliefs about performance in a particular academic task at a specified level - say, constructing a final-year dissertation - in order to accomplish this academic outcome, levels of confidence in engaging in the academic activities necessary to accomplish the task are functions of

those academic activities. In a dissertation task, this may be a student's level of confidence about how likely they are to be able to work out how to construct their primary argument without recourse to tutorial assistance.

2. Recent research using the ABC Scale

Since Sander's re-launch of his Academic Confidence Scale as the Academic Behavioural Confidence (ABC) Scale (Sander & Sanders, 2006a) to date, 25 studies have been found which use the ABC Scale, all conducted with participants in HE. Although ranging quite widely in their foci, all were concerned with using ABC as an evaluator of pre- post- interventions in academic enhancement or engagement programmes, for example, using the metric to assess the effectiveness of new approaches to teaching (Keinhuis et al., 2011; Keinhuis et al., 2013; Nicholson et al, 2013); or to evaluate initiatives such as peer- and other mentoring schemes (Chester et al., 2010; Miller 2015); or using new technology (pod-casts or other online learning devices) as a teaching-and-learning artefact, finding that students who widely used these demonstrated slightly elevated academic self-efficacy; or were interested in exploring specific aspects of students' approaches to their studies - for example, to demonstrate the unpreparedness of access students for wider university programmes (Hlalele, 2010); or finding greater study resilience amongst older students in comparison to their younger peers (McLafferty & McCauley, 2012) or how academic 'grit' (resilience) positively contributes to academic achievement (DeCandia, 2014). Sanders, Daly and Fitzgerald (2016) used the ABC Scale to explore foundation year students' expectations of their academic performance and achievement specifically to determine whether the levels of academic behavioural confidence might forecast attrition and hence be an early indicator of the need for learning development interventions. Findings showed that low scores on the ABC subscales, 'attendance' and 'grades' were good predictors of subsequent likely learning difficulties, with another study demonstrating that starting a learning course with a realistic expectation of a successful outcome is more likely to lead to a successful outcome (Sanders, Mair & Racheal, 2016).

Other studies used ABC to set baseline measures (Hlalele, 2012) or as a profiling tool (Sander et al., 2014) for developing targeted learning development initiatives; or explored transience in students' academic confidence as they progress through their studies at university, where one study showed those with high levels of ABC over-predicted their final grades, suggesting that guidance to 're-calibrate' academic confidence levels should be offered to students as they develop their study skills and gain academic experience (Wesson & Derre-Rendall, 2011). Another study also demonstrated how students' ABC were malleable, showing that students who developed higher levels of ABC as their studies progressed gained better final grades, as did those whose academic expectations were focused and realistic (Putwain et al., 2013), with a further study showing that students' confidence declines during the first year of study due to unrealistic expectations about the academic challenges of their courses. However, by using a system of 'achievement goal profiling', students could be guided towards 'mastery' goals by developing their academic competence in study-related cognitions and behaviours such as effort, persistence, help-seeking, and planning, compared to settling on 'performance' goals, which relied on (academic) comparisons with peers. This demonstrated that early decline in academic confidence could be ameliorated with such interventions.

A significant, further study (n=2429) reiterated Bandura's (2008) argument that there is a bidirectional relationship between [academic] self-efficacy and [academic] performance (de la Fuente, et al., 2013), finding that academic performance influences academic self-efficacy through mastery experience, and that students with high levels of self-efficacy tend to perform better. The study's outcome further concluded that academic confidence, as one aspect of academic self-efficacy, can be a realistic predictor of academic performance, although added that it is not the only predictor with other factors, notably prior achievement, having a significant effect. In the same vein, a later study was grounded in trying to understand which student learning factors might influence teaching and learning parameters so that ways to enhance student academic performance might be suggested (Sander, Putwain & de la Fuente, 2014).

Findings suggested that although academic confidence was an important factor, it was amongst others such as [academic] expectations, emotional stability, and the ‘person-environment fit’. Interpretation of the meaning of academic confidence was that it is an academic self-efficacy measure that assesses more general academic capabilities through exploration of behaviours in academic learning management and study-skill competencies, rather than a more specific. self-efficacy measure which might attempt to gauge confidence to achieve a particular grade target or other clearly defined academic achievement criteria. Hence, that academic confidence, when operationalized as Academic Behavioural Confidence, should be considered more as a multi-dimensional construct rather than as a uni-dimensional one. A recognition of the multi-facetedness of the processes that are mutually interacting in teaching and learning spaces were strongly advocated, notably, these were the relationships between student self-regulated learning processes and those which are external and regulatory as part of the construction of teaching. It was thus argued that ABC is a useful metric for profiling individual learners so that individualized and highly targeted learning development interventions can be designed in response to specific scale-item responses in the ABC Scale.

A related study had explored confidence in study-related skills and behaviours amongst undergraduates (n=206), aiming to relate levels of ABC to academic achievement (Putwain et al., 2013). It was found that academic self-efficacy can be usefully assessed by gauging self-efficacy in self-regulated learning - which is the principle concern of the ABC metric - and that this is then a good predictor of future academic performance. This study also highlighted the value of information derived from the ABC subscales as a means to hone analysis conclusions more specifically. For example, findings showed that levels of students' readiness to engage in the various kinds of study-related skills and behaviours which are required on their courses and which are assessed by the subscales, were strong predictors of their subsequent academic success at the end of their first year. It was also argued that academic learning management information gained about new undergraduates could be useful for designing learning development initiatives that focus on developing perceptions of their own abilities for grounding them at more realistic levels at the beginning of their courses, supporting other studies’ findings (above).

The summary of literature so far demonstrates the increasing interest in academic behavioural confidence as a construct worthy of research in tertiary learning contexts. The design rationale of the ABC Scale as an evaluator of student study behaviours is rooted in a strong theoretical background stemming from Bandura's widely accepted Social Cognitive Theory and the metric

adds to a body of research in support of measuring academic confidence to find out more about how non-cognitive learning parameters impact on student learning effectiveness, and ultimately, their academic achievements at university. Such was the premise that underpinned a substantial meta-analysis (Braithwaite & Corr, 2016) which drew its research rationale from the work of Eysenck.

Although principally a personality theorist, Eysenck also wrote on the relationships between personality and learning, indicating an emphasis for empirical, experimental studies of the effectiveness of education design and pedagogy, that is, how learners' personalities might influence their reactions to specific methods of teaching and the learning environment, and hence how this might impact on their academic attainments (e.g.: Eysenck, 1996). Brathwaite and Corr's meta-analysis looked at 47 studies (n_{total} = 5771) that were all interested in testing methods of enhancing university student self-efficacy and self-confidence attributes as a means to influence a range of academic outcomes. Whilst it must be recognized that the process of combining data from multiple studies has the advantage of creating a much larger datapool, a cautious approach must be adopted to ensure that the parameters being explored in the combined data are as close as possible to those originally measured in each individual study. Ignoring this, not least because studies are rarely exact replications of each other, runs the risk of introducing bias and reducing the credibility of the outcome (Egger et al., 1997; Card, 2015).

Notwithstanding this, the meta-analysis reported small to moderate but statistically significant positive effect sizes across all of the domain outcomes examined, notably in respect of supporting the usefulness of the ABC Scale a significant positive correlation was identified between ABC score and final degree outcome. This was consistent with a much earlier meta-analysis of 39 studies (Multon et al., 1991), which found a statistically significant relationship between self-efficacy and academic performance, although in citing this earlier study, Braithwaite and Corr indicated that because Multon and colleagues had included results from some non-experimental (observational) studies on learning development interventions designed to enhance student self-evaluation processes to impact on a range of university-outcome-capabilities, caution should be adopted in drawing too much from the findings. However, the significance of both of these meta-analyses, caution accepted, is the emergence of evidence that indicates that student learning behaviours, including academic learning management activities, are additional to absolute ability in influencing academic outcomes at university.

Finally, recent use of the ABC Scale took an unusual approach by exploring levels of academic confidence, operationalized through measuring Academic Behavioural Confidence, in relation to past academic experience (Hill, 2017). This enquiry conceptualized prior academic experience as 'academic sustenance' and the research aim was to establish that (current) academic confidence is a function of academic sustenance which Hill determined in her study of Australian undergraduates (n=255) is comprised of 4 factors: encouragement, drive, grounding, and efficacy. Central to Hill's enquiry was advocacy of the increasing importance of understanding more about how university students approach their studies, citing such research areas as motivation and self-efficacy as key elements of successful learning approaches, also arguing for a greater focus to be placed in institutions on more pro-actively developing academic competencies such as critical thinking abilities and multiple timeline academic learning management skills.

Aside from this ethos resonating significantly with the research project reported in this thesis, Hill's use of the ABC Scale is the only one found to date where a study-specific principal component analysis was conducted on the results generated from the application of Sander and Sanders' complete, ABC Scale to the participant cohort, rather than adopting the existing and by now, widely used 4-factor subscales generated from Sander and Sanders' PCA analysis of their own data. As described later, this process of study-specific PCA on data collected through the ABC Scale has been used in the current research project due to being equally unconvinced that the adoption of the 'standard' 4-factor model for determining subscales of the ABC Scale could offer the best analysis outcomes.

V SUMMARY

The ABC Scale has featured in numerous research studies since its development into its current form in the early 2000s. It has been used in studies of university students to explore the contribution that non-cognitive factors may make on the self-regulated learning approaches that are widely expected in HE settings. Some studies have used the scale to evaluate temporal changes, either as a natural course of progression through the university semesters, usually in the first year of study or with students enrolled on access or foundation courses.

Other research has shown that the ABC Scale is useful for gauging the impact of learning development initiatives or interventions on student engagement and achievement. Some significant projects have used the ABC Scale to contribute to developing theories about student-teaching interactions and the learning-teaching interface with the intention of suggesting how these might be modified to enhance learning effectiveness at university with a view to raising academic attainment, or at the other end of the student-learning spectrum, to reduce attrition.

Significantly, many studies have reported that academic confidence, as operationalized through academic behavioural confidence, may be related to academic achievement. It is of note that no published studies have been found which explore how specific learning difficulties such as dyslexia impact on academic confidence at university and hence there appears to be a gap in the research which this research seeks to fill.

3 RESEARCH DESIGN – METHODOLOGY AND METHODS

3.1 Research Design Overview

The research aim was twofold: firstly, to establish the extent of all participants' 'dyslexia-ness', this to be the independent variable; secondly, to gauge their academic confidence in relation to their studies at university, the dependent variable, so that associations between the variables could be explored. This section describes the strategic and practical processes of the project that were planned and actioned to meet that research aim. Details are provided about how practical processes have been designed and developed to enable appropriate data sources to be identified; how the research participants were identified and contacted; how data has been collected, collated and analysed so that the research questions can be properly addressed. This section of the thesis also sets out the development of the Dyslexia Index Profiler, the metric designed and developed exclusively for this project to gauge dyslexia-ness (sub-section 3.6, below). The rationales for research design decisions are set out and justified, and where the direction of the project has diverted from the initial aims and objectives, the reasons for these changes are justified.

Design focus

The project has taken an explorative, mixed methods design focus (see Section 1.2/II-1). This is because little is known about the interrelationships between academic confidence and dyslexia. Hence, no earlier model has been available to provide guidance. Data were collected through a self-report questionnaire, were mainly quantitative, and were collated to enable between-groups analyses to be conducted. This rationale falls within the scope of survey research methodology in which the process of asking participants questions about the issues being explored are a practical and expedient process of data collection, especially where more controlled experimental processes such as might be conducted in a laboratory, or other methods of observing behaviour are not feasible (Loftus et al., 1985). Likert scale item responses were transformed into numerical data for analysis. Some qualitative data were also collected through a free-writing area in the questionnaire for a 'softer' exploration about participants' more general feelings and attitudes to studying at university. In this way, hypotheses formalized from the research questions were addressed objectively using the outputs from the statistical analysis of the quantitative data, with qualitative data used to elaborate discussion points later. This is reported fully In Section 4, Results and Analysis.

3.2 Research Participants

The participants were all students at university and no selective nor stratified sampling protocols were used in relation to gender, academic study level or study status - that is, whether an individual was a home or overseas student. However, all of these parameters were recorded for each participant, and these data have been used throughout the analysis and discussion when considered apposite. It is possible that a later study may re-visit the data to explore differences that might emerge through stratified analysis.

The objective was to establish a sizeable research datapool through convenience sampling that comprised two groups: the first was to be as good a cross-section of HE students as may be returned through voluntary participation in the project. Participants in this group were recruited through advertisements posted on Middlesex University's student-facing webpages during the academic year 2015-16. The second group was to be students known to have dyslexic learning differences. These were recruited through the University's Dyslexia and Disability Service student e-mail distribution list. Recruitment was incentivized by offering participants an opportunity to enter a prize draw subsequent to completing the questionnaire. Amazon vouchers were offered as prizes. From the group of non-dyslexic students, it was hoped that a subgroup of students presenting *quasi*-dyslexia could be identified. It was of no consequence that students with dyslexia may have found their way to the questionnaire through the links from the intranet rather than as a response to the Disability and Dyslexia Service's e-mail, because the questionnaire requested participants to declare any dyslexic learning challenges. Hence, participants would be assigned into the appropriate research group from either recruitment process.

Thus, three distinct datasets were established:

- Students with known dyslexia - designated Research Group DI, and/or referred to as 'the dyslexic group';
- Students with no known dyslexia - designated Research Group ND, and/or referred to as 'the non-dyslexic group';

Through the data collation process, a sub-group of students was established from the non-dyslexic group, being those who presented quasi-dyslexia, as identified by the Dyslexia Index Profiler. This dataset was designated Research Group DNI, and was also referred to as 'the quasi-dyslexic subgroup'.

Hence, it was possible to compare levels of academic confidence between the three groups.

3.3 Data collection: Materials and Measures

I Objectives

As this project is focused on finding out more about the academic confidence of university students and relating this to levels of dyslexia-ness, the data collection objectives were:

- to design and build a data collection instrument that could gather information about academic confidence and aspects of dyslexia-ness, expediently and unobtrusively from a range of university students, in information formats that could easily be collated and statistically analysed once acquired;
- to ensure that the data collection instrument was as clear, accessible and easy-to-use as possible, noting that many participants would be dyslexic;
- to ensure that the data collection instrument could acquire information quickly (15 minutes was considered as the target) to maintain research participant interest and attention;
- to design an instrument that could be administered online for participants to engage with at their convenience;

- to enable participants to feel *part* of a research project rather than its *subjects*, and hence engage with it and provide honest responses;
- to maximize response rates and minimize selection bias for the target audience;
- to ensure compliance with all ethical and other research protocols and conventions for data collection according to guidelines and regulations specified by the researcher's home university.

These objectives were met by designing and building a self-report questionnaire. Carefully constructed survey questionnaires are widely used to collect data on individuals' feelings and attitudes that can be easily quantified to enable statistical analysis (Rattray & Jones, 2007). Questionnaires are one of the most commonly used processes for collecting information in educational contexts (Colosi, 2006). Evidence shows that self-report questionnaires have been found to provide reliable data in dyslexia research (e.g.: Tamboer et al., 2014; Snowling et al., 2012). Developments in web-browser technologies and electronic survey creation techniques have led to the widespread adoption of questionnaires that can be delivered electronically across the internet (Ritter & Sue, 2007) and so this process was used. The ability to reach a complete community of potential participants through the precise placement and marketing of a web-based questionnaire was felt to have significant benefits. These included:

- the ability for the researcher to remain inert in the data collection process to reduce any researcher-induced bias;
- the ability for participants to complete the questionnaire privately, at their own convenience and without interruption, which it was hoped would lead to responses that were honest and accurate;
- ease of placement and reach, achieved through the deployment of a weblink to the questionnaire on the home university's website;
- ease of data submission, and data conversion on receipt;
- the facility for strict confidentiality protocols to be applied whereby a participant's data, once submitted, were to be anonymous and not attributable to the participant by any means.

Every questionnaire response received was anonymised at the submission point with a randomly generated 8-figure Questionnaire Response Identifier (QRI). The QRI was automatically added to the response dataset by the post-action process for submitting the form as an e-mail. Should any participant subsequently request revocation of data submitted, this was achieved by including the QRI in the revocation request form, also submitted electronically and received anonymously. No participants requested this.

II QUESTIONNAIRE DESIGN RATIONALES

The questionnaire was designed to be as clear and as brief as possible. Notably, guidance provided by the British Dyslexia Association was helpful in meeting many of the design objectives. Additional literature was consulted about designing accessible online and web-based information systems, with particular attention to text formats and web design for visually impaired and dyslexic readers to ensure dyslexia-compliant readability (Gregor & Dickinson, 2007; Kurniawan, 2007; Al-Wabil et al., 2007; Beacham & Alty, 2006; Evett & Brown, 2005); to explore how dyslexia-friendly online webpage design may have been reviewed and updated in the light of the substantial, relatively recent expansion of online learning initiatives (e.g.: Rello et al., 2012; Chen et al., 2016; Berget et al., 2016); and how strong accessibility protocols not only enabled better access for those

with dyslexia, or who experienced visual stress or other vision differences, but provided better accessibility and more straightforward functionality for everyone (McCarthy & Swierenga, 2010; Rello et. al, 2012; de Santana et.al., 2013). Other literature was consulted about the impact of design and response formats on data quality (Maloshonok & Terentev, 2016), on response and completion rates (Fan & Yan, 2010), on the effectiveness of prize draw incentivizations (Sanchez-Fernandez et al., 2012), and invitation design (Kaplowitz et al., 2011), and about web form design characteristics recommended for effectiveness and accessibility (Baatard, 2012). The questionnaire design stage reviewed existing web survey applications for customizability and flexibility, noting that Google Forms (Google, 2016), SurveyMonkey (Survey Monkey, 2016), SurveyLegend (Survey Legend, 2016), Polldaddy (Automattic, 2016), Survey Planet (Survey Plant, 2016), Survey Nuts (Zapier Inc., 2016), Zoho Survey (Zoho Corp., 2016) and Survey Gizmo (Widgix, 2016), were all limited by strictly constrained design and functionality options; advertising, or custom branding. None of the apps reviewed included the functionality of range input sliders.

Hence the project questionnaire was designed within these design rationales:

- it was an online questionnaire that rendered properly in at least the four most popular web-browsers: Google Chrome, Mozilla Firefox, Internet Explorer, Safari (usage popularity respectively 69.9%, 17.8%, 6.1%, 3.6%, data for March 2016 (w3schools.com, 2016));
- text, fonts and colours were carefully chosen to ensure that the questionnaire was attractive to view and easy to engage with, meeting W3C Web Accessibility Initiative Guidelines (W3C WAI, 2016);
- an estimate was provided about completion time (15 minutes);
- questions were grouped into five, short sections, each focusing on a specific aspect of the research, with each question-group viewable one section at a time. This was to attempt to reduce survey fatigue and poor completion rates (McPeake et al., 2014; Ganassali, 2008; Flowerdew & Martin, 2008; Marcus et al., 2007; Cohen & Manion, 1994); In the event, only 17 of the 183 questionnaires returned were incomplete (9.2%).
- the substantial part of the questionnaire used Likert-style items in groups, presenting response options using range sliders to gauge agreement with statements;
- the questionnaire scale item statements were written as neutrally as possible, or in instances where this was difficult to phrase, a blend of negative and positive phrasing was used (e.g.: Sudman & Bradburn 1982). This was an attempt to avoid tacitly suggesting that the questionnaire was evaluating the impacts of learning difficulty, disability or other learning challenge on studying at university, but rather that a balanced approach was being used to explore a range of study strengths as well as challenges;
- a free-writing field was included to encourage participants to feel engaged with the research by providing an opportunity to make further comments about their studies at university in whatever form they wished. This had proved to be a popular feature in the preceding dissertation questionnaire (Dykes, 2008), providing rich, qualitative data;

The questionnaire was built, tested and published on the project webpages which had been established and hosted on the researcher's private web server, not least as this presented the most expedient means to retain complete control over both the content and security of the webpages. The questionnaire remains available here.

III QUESTIONNAIRE COMPONENTS

The questionnaire comprised three main sections: The first presented demographic data fields that all participants were to complete. The second section comprised quantitative data collection fields to explore academic confidence and dyslexia-ness. The final section collected qualitative data.

1. DEMOGRAPHIC DATA

Data were collected on gender, student domicile ('home' or 'overseas') and student study level, with options provided from Foundation Level 3/4 to post-doctoral researcher Level 8 (QAA, 2014). This preliminary section also asked students with dyslexia how they learned of their dyslexia by selecting options from two drop-down menus to complete a sentence (Figure 8), thus collecting data to address Hypothesis 3 (see sub-section 1.4).

Figure 8 Selecting how dyslexic students learned of their dyslexia

2. QUANTITATIVE DATA

LIKERT SCALES

Likert-style scales were used to collect quantitative data throughout the questionnaire. Participants reported their degree of agreement with each scale-item statement using a continuous response scale approach. This was developed for this project in preference to traditional, fixed anchor point scale items because the data produced are arbitrarily coded so that they can be statistically analysed but this makes the data neither authentic nor actual (Carifio & Perla, 2007; Carifio & Perla 2008; Ladd, 2009). Hence by using range sliders, data quality may be increased (Funke & Reips, 2012), and would be as close to continuous as possible, thus enabling parametric analysis to be reasonably conducted (Jamieson, 2004; Pell, 2005; Carifio & Perla, 2007; 2008; Grace-Martin, 2008; Ladd, 2009; Norman, 2010; Murray, 2013, Mirciouiu & Atkinson, 2017). In this questionnaire, the continuous scales were set as percentage agreement, ranging from 0% to 100%, hence corresponding to participants strongly disagreeing to strongly agreeing respectively, with each statement.

1 THE ACADEMIC BEHAVIOURAL CONFIDENCE SCALE:

Academic confidence was assessed using the existing, ABC Scale (Sanders, 2006b), which is known to be a reliable evaluator of the academic confidence of university-level students by examining their study behaviours and actions (see Section 2.2). Using the 24-item scale, Sander and colleagues reported it to possess an internal reliability of $\alpha = 0.88$ (2007), based on data acquired from a sample of 284 participants drawn from two UK universities. All other studies using

the ABC Scale found to date, appear to have either relied on this α-value, or only report the internal reliability of the ABC Scale's sub-scales, as derived by prior dimension reduction (op cit). With one exception, no other studies were found that indicated item redundancy analysis nor dimension reduction of the ABC 24-item scale as a mechanism for a more nuanced analysis of local data. The exception was a short conference paper detailing a statistical evaluation of the factor structure of the preceding, Academic Confidence Scale, that used data collected from a local university (Corkery, et.al., 2011), and although no overall measure for scale reliability was indicated, coefficients for the three subscales were presented, with values ranging from $0.711 < \alpha < 0.880$.

Currently, no other metrics exist which explicitly focus on gauging confidence in academic settings (Boyle et al., 2015). Evaluators exist to measure self-efficacy or academic self-efficacy, which, as also described in Section 2, is considered to be the umbrella construct that includes academic confidence (Sander & Sanders, 2003). However, of all such measures, the ABC Scale most closely matched the research objectives of this study. The full scale of 24 items includes dimensions such as: 'I am confident that ...

- ... I can study effectively in independent study';
- ... I can present to a small group of peers';
- ... I can prepare thoroughly for tutorials'.

The complete scale is listed in Appendix 8.1(II).

2.1 Six Psychometric Scales:

The data collection process of the earlier, MSc dissertation (Dykes, 2008) had developed psychometric scales where the purpose was to explore feelings and attitudes of dyslexic students to their dyslexia in the context of their university studies. The rationale was based on evidence from literature which suggested that discernible differences between dyslexic and non-dyslexic individuals for each of these six constructs. For example, levels of self-esteem are depressed in dyslexic individuals in comparison to their non-dyslexic peers (e.g.: Riddick et al., 1999; Humphrey, 2002; Burton, 2004; Alexander-Passe, 2006; Terras et al., 2009; Glazzard, 2010; Nalavany et al., 2013); and Klassen et al. (2008) found that dyslexic students exhibit significantly higher levels of procrastination when tackling their academic studies at university in comparison to students with no indication of dyslexia. In the early stage of the research design process for this current study, it was planned that these six subscales would be combined into a profile chart to enable quasi-dyslexic

students to be discriminated from the group of non-dyslexic students by comparing their profiles with mean-data profiles of the dyslexic and non-dyslexic groups overall. The resulting, overlapping visualizations were distinct (Figure 9, generated from observed data collected later from the quasi-dyslexic subgroup), but it was considered doubtful that the complete set of profiles would show sufficient discriminative power to be reliable for identifying quasi-dyslexic students. Hence this approach was abandoned in lieu of developing an alternative, quantitative process as the discriminator between dyslexic, non-dyslexic, and quasi-dyslexic students, which emerged as the Dyslexia Index Profiler (below, Section 2, Part 2). Nevertheless, the profile chart visualizations were intriguing, suggesting that this data may have value, and so this section of the questionnaire was not deleted, and has been reserved so that the idea may be explored and reported later, perhaps as part of a subsequent study.

2.2 The Dyslexia Index Profiler

The Dyslexia Index (Dx) Profiler was a 20-item scale developed especially for this project (see Section 3.6 below for an account of the rationale, theoretical underpinnings, and development processes, including details about the small-scale enquiry that was conducted to validate the Profiler). It became necessary as a consequence of significant reservations about the likelihood of the visual profile approach (based on outputs from the six psychometric scales) to discriminate the sub-group of quasi-dyslexic students from the non-dyslexic group reliably and with sufficient precision.

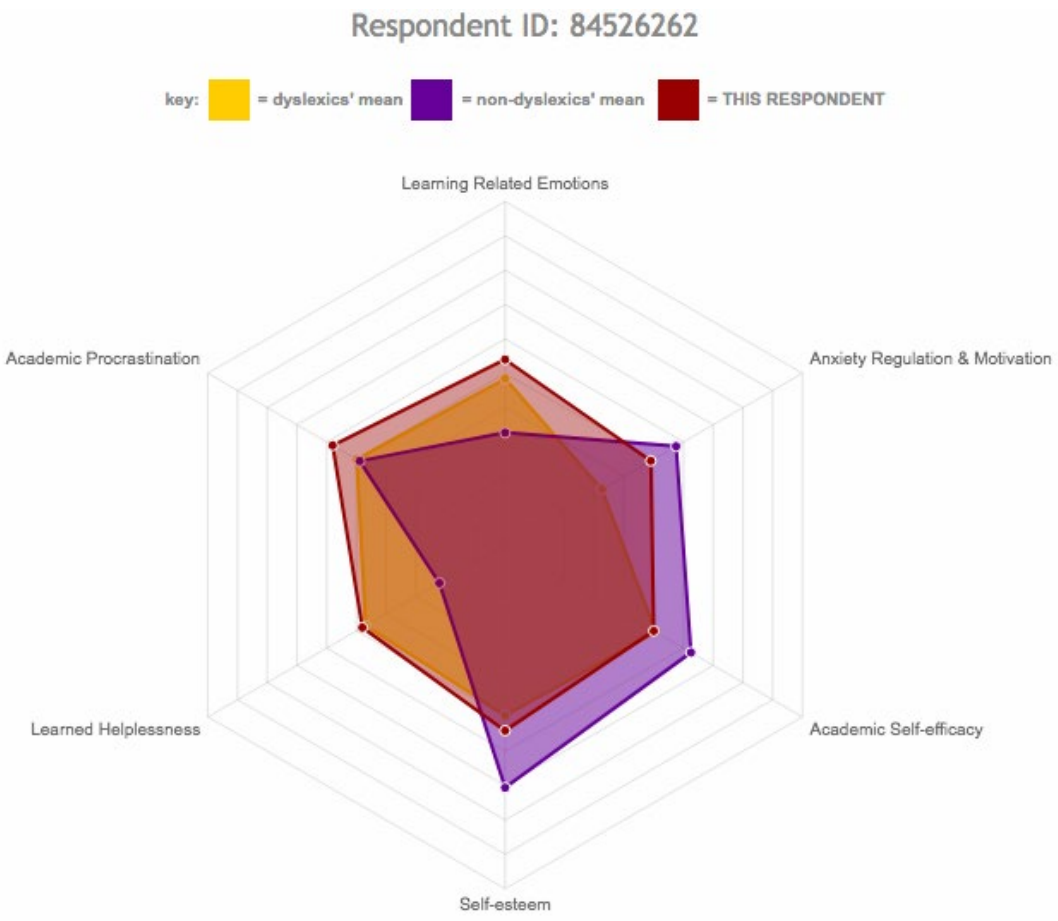


Figure 9: Profile chart for a participant in the quasi-dyslexic subgroup

The final iteration of the Profiler comprised 20 scale items, gauged with the continuous range input sliders consistent with quantitative data collection processes devised for the other sections of the questionnaire. Scale items explored a range of dimensions of dyslexia, expressed as statements to which participants registered levels of agreement on a range of 0-100%. The combined output enabled an aggregated Dyslexia Index 'score' to be generated, considered as the level of dyslexia-ness (for the purposes of this study). Scale items included for example:

- 'When I was learning to read at school, I often felt I was slower than others in my class';
- 'I have difficulty putting my writing ideas into a sensible order';
- 'I get in a muddle when I'm searching for learning resources or information';

The complete scale is listed in Appendix 8.1(II). As the Dx Profiler was developed for this project and no previous studies have devised or included any similar scales or gauging processes for evaluating dyslexia-ness, no prior reliability data were available. However, an internal scale reliability assessment was conducted post hoc using the conventional Cronbach's α procedure, which delivered a scale reliability coefficient of α = 0.849 (see sub-section 4.3/III.1 below).

3. Qualitative Data

The final part of the questionnaire collected qualitative data in an optional, unlimited free-writing area. Participants were invited to comment on any aspects of the research, the questionnaire, or their learning experiences at university more generally. Including this final section was based on the usefulness of the rich and varied data that had been acquired in a similar way in the questionnaire used in the earlier, MSc. dissertation. In that study, it became evident that providing a conduit for students with dyslexia to provide comments and feedback about how they felt about their study at university was heartily welcomed. The data captured was used to elaborate the discussion element of the dissertation. Hence it was considered that adopting a similar approach in this current study would be of value.

4. Questionnaire Pilot

The questionnaire was trialled amongst a small group of students (n=10) local to the researcher to gain feedback about its style of presentation, ease of use, the clarity of the questions and statements, the quality of the introduction, the length of time it took to complete, any issues that had arisen in the way it had displayed in the web-browser used, and to elicit any other comments that might indicate that a review or partial review would be necessary before deployment to the target audience. The outcome of this pilot indicated that other than some minor wording changes, no amendments were required.

3.4 Procedure

On completion of the design, development, testing and piloting processes, the questionnaire was uploaded to the project's webpages for electronic deployment. To recruit students into the dyslexic group, co-operation from the University's Dyslexia and Disability Service was obtained so that an

Invitation to Participate in the project could be sent to all students registered with the Service through an e-mail distribution list. The invitation included a link to the questionnaire. To recruit non-dyslexic students, similar co-operation was obtained from the University's website development team to enable publicity about the project to be posted on the student-facing intranet home page, which included the Invitation to Participate and a link to the questionnaire.

Completed questionnaires were submitted automatically by e-mail to the researcher in a format that permitted direct transfer to an Excel spreadsheet for collation and subsequent inspection and analysis.

3.5 DATA REDUCTION

A Dyslexia Index was calculated for each participant using the weighted mean average process applied to the 20 scale-items, developed at the design stage of the Dx Profiler in the light of the analysis of the pilot study (see Section 3.6 below). This value was scaled up by a factor of ten so that it was easy to discriminate from the similarly gauged level of Academic Behavioural Confidence, and this Dx value was taken to indicate each participant's level of dyslexia-ness.

Students from the non-dyslexic group whose Dyslexia Index exceeded critical boundary values were categorized as *quasi*-dyslexic (see sub-section 4.3/III, part III(1) below) for the discriminating rationale).

Later reliability analysis of the Dx Profiler indicated a possible, reduced-item scale where 4 scale items were identified as likely to be redundant (see sub-section 4.3/III.1). This enabled alternative measures of dyslexia-ness to be calculated for each participant. In the event, both outputs were considered of merit and implications are reported below (Section 4.3).

To gauge academic confidence, each participant's ABC value was initially calculated using a non-weighted mean average of the 24 scale-item responses (which each offered a range from 0 to 100), leading to an output of $0 < ABC < 100$. Subsequent to dimension reduction analysis later, (see sub-section 4.5 below), three further ABC Scales were used to re-calculate values. Hence this complete process led to permutations of the two Dx Profilers with the four ABC Scales being available to consider later. The complete datapool was transferred into SPSS v24 (IBM Corp, 2016) for further analysis.

Given that both scales were gauging multi-dimensional, continuous variables, further analysis was subsequently conducted to determine whether dimension reduction could reveal meaningful factor structures. Early iterations suggested a local factor structure for the ABC Scale was likely to emerge, although for the Dx Profiler, outcomes were less clear. Hence a parallel (simulation) process was applied through the Eigenvalue Monte Carlo Simulation protocols, to determine the number of factors which were likely to occur using multiple simulated reductions of randomized versions of the experimentally acquired data. Outcomes confirmed a factor structure for the ABC Scale, and also indicated that the Dx Profiler, especially when already reduced to a 16-item scale was most likely to be uni-dimensional.

3.6 Developing the Dyslexia Index Profiler

Developing the Dyslexia Index (Dx) Profiler became a major component of the research design process. The entire project relied on this, as the main focus was to discover whether levels of academic confidence are influenced differently by dyslexia, quasi-dyslexia, and non-dyslexia, and that differences that emerge may be attributable to the dyslexic label. Many students with dyslexia at university may have developed strategies to compensate for literacy-based difficulties experienced in earlier learning histories, partly by virtue of their academic capabilities (see Section 2). Hence in HE contexts, other aspects of the dyslexic self may impact significantly on academic study. For example, it has been argued that to consider dyslexia to be only a literacy issue, or to focus on cognitive aspects such as working memory and processing speeds, may be erroneous (Cameron, 2015), and developing procedures to operationalize effective self-managed learning strategies need to be considered (Mortimore & Crozier, 2006). This is especially so, as self-regulated learning processes are recognized as a significant feature of university learning experiences (Zimmerman & Schunk, 2011; Broadbent & Poon, 2015). Hence, a metric was required which viewed university study attributes and behaviours through the lens of dyslexia, but which was not designed to be a dyslexia screener.

I Background and rationale

Development of the Dx Profiler has been a complex process that built on pertinent theory about the broad and multifactorial nature of dyslexia (discussed in Section 2.1/II.6). To have used a proprietary dyslexia screener would have raised ethical challenges related to disclosure for participants in the non-dyslexic group, hence compromising the requirement for data collection anonymity. Stated use of a screener may also have introduced bias where participants who were not (identified as) dyslexic may have answered some parts of the questionnaire untruthfully through fear of being identified as dyslexic. Such fear is widely reported, in particular, amongst health professionals (e.g.: Shaw & Anderson, 2018; Evans, 2014; Ridley, 2011; Morris & Turnbill, 2007; Illingworth, 2005).

II Establishing the Dyslexia-ness Continuum

The broad definition of dyslexia outlined by the BDA acknowledges much of this wider discourse about the nature and aetiology of the syndrome, discussed throughout Section 2.1. Critically, this definition frames dyslexia as a continuum, which firstly acknowledges that categorical distinctions within the syndrome are problematic; but also suggests that no clear-cut point along this continuum can be universally fixed to indicate the boundary between dyslexic and non-dyslexic individuals. This is despite the desire to do so, not least to enable decisions to be made concerning the award of financial learning support allowances for students at UK universities.

Adopting the continuum approach, therefore, adds substance to the concept of 'dyslexia-ness', introduced for this current study. Thus, it is reasonable to infer that the characteristics and attributes of dyslexia that are embraced within the definition, and which are the components of dyslexia-ness, might be measured in some way once distilled back into dimensions. This leads to the possibility for exploring either dimensions unilaterally, or groups of dimensions (perhaps combined into factors), or the complete the complete portfolio of dimensions - that is, dyslexia-ness. According to their dyslexia-ness 'score', it will be possible to locate quasi-dyslexic and non-

dyslexic individuals at some point along the continuum relative to their more dyslexic peers, or sift individuals who share similar levels of dyslexia-ness into sub-groups.

Hence, The Dyslexia-ness Continuum is established (Figure 10), and can be regarded as a continuous, independent variable against which other study attributes, such as academic confidence, can be examined as the corresponding dependent variable. In this way, tentative comparisons might then be made between groups and sub-groups of, in this case, students at university, naturally leading to a mechanism for deducing more generalized results. Indeed the idea of a dyslexia-ness continuum, might warrant further development, the first part of which should be to devise an alternative descriptor for it that removes, or at least dilutes, the allusion to the continuum being an evaluation of dyslexia, instead, that it is a continuum of learning development characteristics, skills and behaviours that has meaning and relevance in higher education contexts. Whilst this is not to ignore or dismiss the idea of dyslexia per se, such a process might help to relocate it more positively within a multifactorial portfolio of learning and study attributes that could also reduce much of the stigmatization associated with 'difference' in learning contexts (Osterholm, et.al., 2007; Ho, 2004; Riddick, 2000).

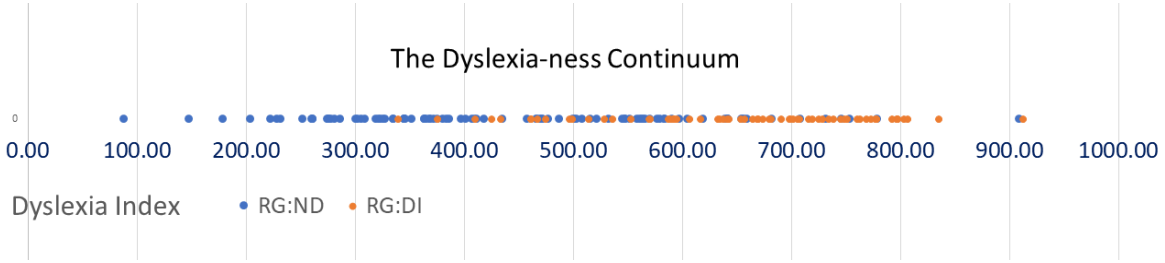


Figure 10: The Dyslexia-ness Continuum - displaying data from this current study

To operationalize The Dyslexia-ness Continuum through the Dyslexia Index (Dx) Profiler, with each participant's Dyslexia Index providing the continuum locater, these design criteria were established:

- the profiler was to be a self-report tool requiring no administrative supervision;
- the profiler was to be ethically non-controversial, not labelled as a dyslexia screener, and with data collected anonymously;
- the profiler item statements were to be as applicable to non-dyslexic as to dyslexic students;
- it would include a balance of literacy-related and wider, academic learning-management and study-behaviour evaluators;
- it would include elements of learning biography;
- although Likert-style based, scale item statements were to avoid fixed anchor points by presenting participant selectors as a continuous range option;
- scale item statements would aim to minimize response distortions potentially induced by negative affectivity bias (Brief, et al., 1988);
- scale item statements would aim to minimize participant auto-acquiescence, that Is, 'yea-saying', being the often-problematic tendency to respond positively to attitude statements (Paulhaus, 1991). Thus, the response indicator design would require a fine gradation of level-judgment to be applied;
- although not specifically designed into the suite of scale-item statements at the outset - which were presented in a random order - natural groupings of statements as sub-scales were expected to emerge, leading to the possibility for factor analysis might be applied later, if appropriate;

- scale item statements were to avoid social desirability bias, that is, the tendency of participants to self-report positively, either deliberately or unconsciously. In particular, an overall neutrality should be established for the complete Dx Profiler so that it would be difficult for participants to guess how to respond to present themselves in a favourable light (Furnham & Henderson, 1982).

III Designing the Dx Profiler

In addition to being grounded in the most recent BDA definition of dyslexia, several other evaluators were consulted for guidance. In particular: the BDA's Adult Checklist developed by Smythe and Everatt (2001); the original Adult Dyslexia Checklist proposed by Vinegrad (1994), upon which many subsequent checklists appear to be based; and the later, York Adult Assessment (YAA) (Warmington et al., 2012) which has a specific focus as a screening tool for dyslexia in adults, were all explored. Despite the limitations outlined earlier (sub-section 2.1(VII)), the YAA was found to be usefully informative. But also consulted and adapted has been the 'Myself as a Learner Scale' (Burden, 2000); the useful comparison of referral items used in screening tests which formed part of a wider research review of dyslexia by Rice and Brooks (2004); and especially more recent work by Tamboer and Vorst (2015) where both their own self-report inventory of dyslexia for students at university, and their useful overview of previous studies were consulted.

Drawing from all of these sources, and from supporting literature, a portfolio of 20 statements was devised for gauging attributes of study behaviours and learning biography that are known to present characteristic differences between dyslexic and non-dyslexic students, thus setting out the framework for the Dx Profiler (Table 2). Dimensions are

Dim #	*Statement*	*Aiming to gauge differences in: ...*	*Supporting references**
01	When I was learning to read at school, I often felt I was slower than others in my class	Reading fluency confidence, reading anxiety	Critchley, 1970, [2.1/I]; Lombardino & Gauger, 2014, [2.1/I]; Stanovich, 1988, [2.1/II(1)];
02	My spelling is generally good	Spelling confidence	Critchley, 1970, [2.1/I];
03	I find it very challenging to manage my time efficiently	Organization and time-management competencies	Kirby et.al., 2008;
04	I can explain things to people much more easily verbally than in my writing	Preferences/avoidances for communicating knowledge and expressing ideas; visualization into verbalization;	Hummel, 2004;
05	I think I am a highly organized learner	Organization and time-management competencies	Miles, 1993; Jacklin et.al., 2007, [2.1/VII];
06	In my writing, I frequently use the wrong word for my intended meaning	Word confusion; word retrieval	Reid, 2011; le Jan et.al., 2009 [2.1/I];
07	I generally remember appointments and arrive on time	Organization and time-management competencies	Klein, 1993; Farmer, et.al., 2002; Mortimore & Crozier, 2006;
08	When I'm reading, I sometimes read the same line again or miss out a line altogether	Reading fluency, particularly visual tracking	le Jan et.al., 2009 [2.1/I]; Stein, 1991, [2.1/II(2)]; Bellocchi et.al., 2013, [2.1/II(2)];
09	I have difficulty putting my writing ideas into a sensible order	Thinking-to-writing coherence; competencies with linear processes	Tamboer & Voorst, 2015, [2.1/VII]
10	In my writing at school I often mixed up similar letters, like 'b' and 'd' or 'p' and 'q'	Learning-to-read history, specifically incidence of letter reversals	Orton, 1928, [2.1/II(2)]; Liberman et.al., 1971; Lane, 1988; Lachman & Geyer, 2003;
11	When I'm planning my work, I use diagrams or mindmaps rather than lists or bullet points	Thinking and processing, more specifically: holistic or divergent, compared to linear thinking process preferences	Heinman & Procel, 2003; Mortimore, 2008, [2.1/III]; Attree et.al., 2009, [2.1/III]; Brunswick, et.al. 2010, [2.1/III]; Draffen et.al.,2014, [2.1/III];
12	I'm hopeless at remembering things like telephone numbers	Perception of memory retrieval competencies	Vellutino et.al., 1996; Tambour et.al., 2016, [2.1/II(6)]

13	I find following directions to get to places quite straightforward	Perception of working/ST memory competencies; linear thinking competencies	Miles, 1993; Vellutino et.al., 1996; Pickering, 2012, [2.1/II];
14	I prefer looking at the 'big picture' rather than focusing on the details	Preference for 'overview' cf 'detail' thinking and processing competencies; use of concept mapping tools;	Draffen et.al., 2007; Lami & Locatelli, 2008;
15	My friends say I often think in unusual or creative ways to solve problems	Evidence for divergent thinking; creative problem-solving	Everatt et.al., 1999; Cockroft & Hartgill, 2004;
16	I find it really challenging to follow a list of instructions	Reading fluency -> verbal processing -> W/ST memory,	Jeffries & Everatt, 2004, [2.1/II];
17	I get my 'lefts' and 'rights' easily mixed up	Laterality	Ginsburg & Hartwick, 1971;
18	My tutors often tell me that my essays or assignments are confusing to read	Thinking organization/linearity, more specifically: competencies in adapting 'grasshopper thinking' into organized, systematic, linear writing coherence	Cameron, 2016, [2.1/V]
19	I get in a muddle when I'm searching for learning resources or information	Thinking and processing, more specifically: competencies in systematic activities; working/ST memory; thinking linearity;	MacFarlance et.al., 2012; Berget & Sandnes, 2015;
20	I get really anxious if I'm asked to read 'out loud'	Reading fluency confidence, reading anxiety	Riddick et.al., 1999; Carroll & Iles, 2006;
			** additionally referring to Section 2 (Literature Review) where citations have supported the discussion points raised.*

Table 2: Dyslexia Index statements with attributes and characteristics of dyslexia-ness each aims to be gauging, together with supporting reference

listed in the order in which they appeared in the final iteration of the main research questionnaire. Participants were requested to gauge the magnitude of their agreement with each of the statements by adjusting the position of the range input slider from its default, 50%, position towards 0% or 100% agreement accordingly.

The Profiler was to be aligned with the BDA (2018) definition of dyslexia, as adopted for this current study, (see Section 2.1/I), and this definition was distilled into three components: language and literacy skills; thinking and processing skills (encompassing issues related to working/short-term memory, but also to include creative strengths); and organization and time-management competencies. The statements in the Profiler were located across the three components accordingly (below), setting out a framework that might be validated from post-hoc factor analysis of results acquired from participants in this study later given that this was a newly devised metric (see sub-section 4.5/III).

COMPONENT: Literacy and language

- accurate and fluent word reading and spelling;
- phonological awareness;
- [other] aspects of language (eg: writing coherence);
- visual processing challenges;

Dimensions:

'When I was learning to read at school, I often felt I was slower than others in my class'
'My spelling is generally good'
'In my writing, I frequently use the wrong word for my intended meaning'
'When I'm reading, I sometimes read the same line again or miss out a line altogether'
'I have difficulty putting my writing ideas into a sensible order'
'In my writing at school I often mixed up similar letters, like 'b' and 'd' or 'p' and 'q''
'My tutors often tell me that my essays or assignments are confusing to read'
'I get really anxious if I'm asked to read 'out loud''

COMPONENT: Thinking, processing, memory:

- verbal memory;
- verbal processing speed;
- mental calculation;
- concentration;
- information synthesis;
- design, problem-solving ingenuity, creativity;

Dimensions:

'I can explain things to people much more easily verbally than in my writing'
'I get in a muddle when I'm searching for learning resources or information'
'I'm hopeless at remembering things like telephone numbers'
'I find following directions to get to places quite straightforward'
'I prefer looking at the 'big picture' rather than focusing on the details'
'My friends say I often think in unusual or creative ways to solve problems'
'I find it really challenging to follow a list of instructions'

'I get my 'lefts and 'rights' easily mixed up'

COMPONENT: Organization and time management

- personal organization;

Dimensions:

'I find it very challenging to manage my time efficiently'

'I think I am a highly organized learner'

'I generally remember appointments and arrive on time'

'When I'm planning my work, I use diagrams or mindmaps rather than lists or bullet points'

The multifactorial nature of the syndrome implies that attributes are presented in varying degrees in each individual, and that some of the attributes devised are not likely to be uniquely located into any single component. For example, it is reasonable to suppose that the statement '*I get in a muddle when I'm searching for learning resources or information*' may be variably influenced by criteria from the skillsets of all three components. How this variability may appear was unknown at the design stage of the Dx Profiler due to the unique, individual distribution of attributes across factors. Nevertheless, a draft of a possible mapping was constructed (Figure 11) which would be compared later with the output derived from the dimension reduction analysis of observed data, where attribute-factor overlap would be determined by relative factor loadings should these emerge from this process

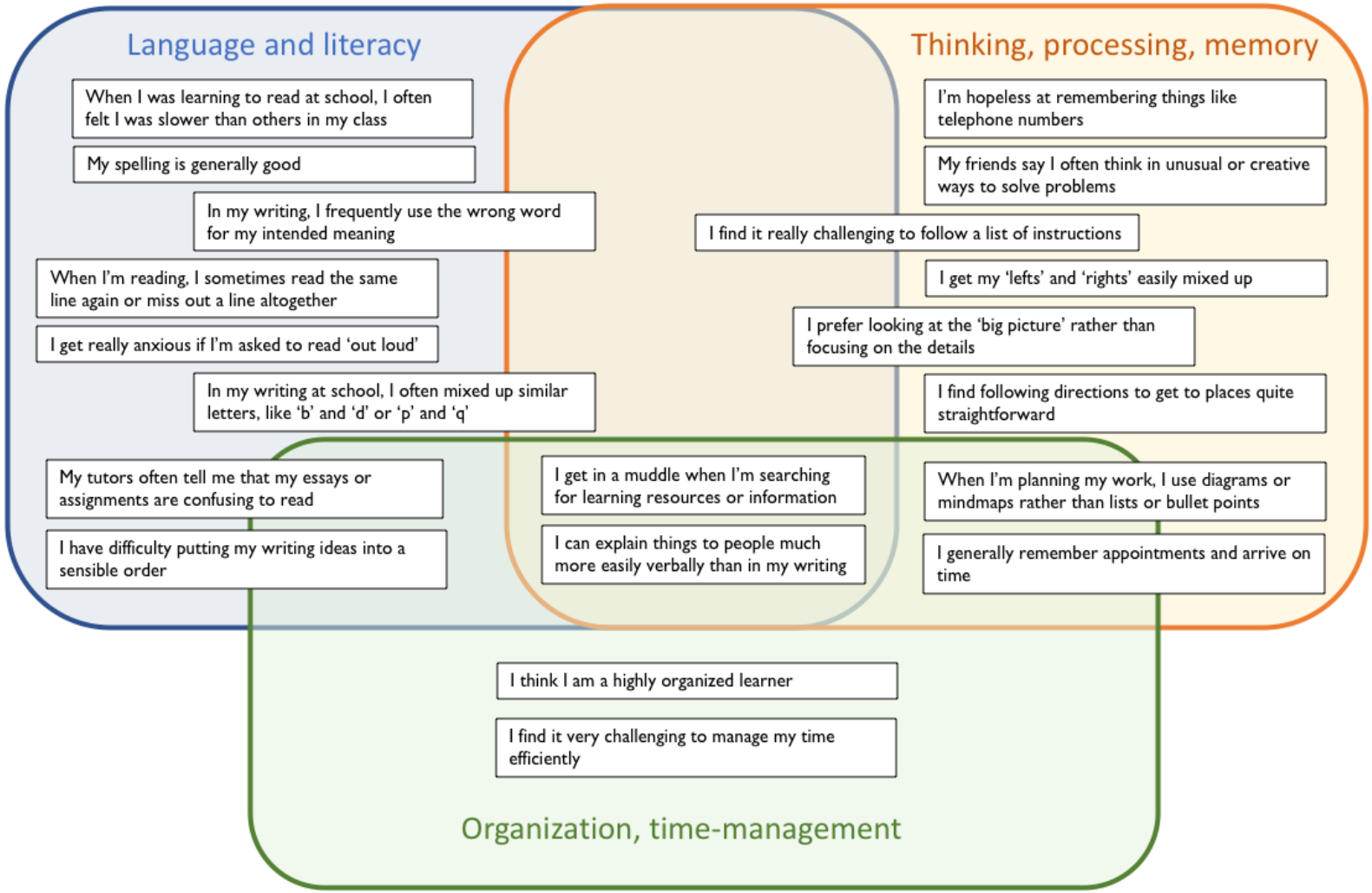


Figure 11: Dyslexia dimensions distributed across BDA components

IV Validating the Dx Profiler

Before deploying the Dx Profiler as part of the research questionnaire, two further factors were considered pertinent: firstly, it was important to gain a tentative confirmation that the statements devised resonate with the learning and study experiences of students at university, and hence might be a realistic attempt to gauge the levels of dyslexia-ness of participants in this current project; and secondly, that a reasonable estimate of the *prevalence* of each dimension could be gained to justify the adjustment of the numerical overall output of the Dx Profiler using a *weighted* rather than a simple mean-average of scores obtained from the complete set of 20 dimensions. It was reasonable to suppose that were prevalence data ignored, outputs from the Profiler would be certainly less realistic, and possibly significantly skewed.

To meet these objectives, feedback was sought about the proposed portfolio of statements ahead of finalizing the Dx Profiler and incorporating it into the main research questionnaire. As the Profiler was to be a metric for use in university settings, the rationale for obtaining such feedback focused on obtaining data from that environment, specifically, from dyslexia support professionals. It seemed reasonable to assume that these members of university support services staff are likely to have day-to-day interactions with dyslexic students at university, and hence should have a good sense of how regularly they encounter the dimensions of dyslexia enshrined in the statements. Hence, a small-scale enquiry was devised, being a short, online poll designed, built and hosted on the project's webpages which sought to gauge the prevalence and frequency of dyslexia characteristics and attributes that were to be incorporated into the Dx Profiler.

1. Rationale, Methods and Processes:

The rationale for this enquiry was threefold:

- By exploring the prevalence of attributes (dimensions) of dyslexia observed in the field in addition to those distilled through the theory and literature reviewed to that point, it was hoped that the data acquired would confirm that the dimensions being gauged were appropriate and recognizable features of the learning and study profiles of dyslexic students at university;
- Through analysis of the data collected, value weightings could be ascribed to each dimension based on their reported prevalence. Hence the output of the Dx Profiler in the main research questionnaire would account for the likely relative influence of each dimensions by generating a weighted-mean average level of dyslexia-ness for each participant;
- Feedback could be sought about the design and operation of the continuous range input sliders (Fig 12) being trialled in this poll, as these were planned to be extensively used in the main questionnaire later.

The poll (available here) contained 18 statements, mirroring those to be used in the Dx Profiler later. The list of statements was prefixed with the question: *'In your interactions with students, to what extent do you encounter each of these dimensions?'* Participants recorded their answer as a percentage where 0% indicated 'never encountered', 50% indicated 'encountered in about half of interactions', and 100% indicated 'all the time'. The default position was set at the midpoint of the

Figure 12: Likert-style scale item continuous range input slider used in the Straw-Poll of dyslexia practitioners

slider scale (Figure 12), noting that the default position of input range sliders has been reported to have no significant impact on output (Couper et al., 2006).

2. Recruitment of participants

Of the 132 UK Higher Education Institutions identified through the Universities UK database, 116 were identified with Student Support Services that included an indicated provision for students with dyslexia, generally as part of more general services for students with disabilities. These were established through inspection of institutions' outward-facing webpages. Most provided a specific e-mail address for contacting the team of dyslexia specialists directly, or otherwise a more general enquiry address for student services was available. All 116 institutions were contacted to invite participation in the enquiry by including a link to the poll in the e-mail. The response rate of 30/116 institutions was disappointing, although was considered sufficient for meeting the objectives of the poll given the absence of alternative data.

3. Process

An introduction to the poll described its purpose, provided instructions about how to complete it, and how to request withdrawal of data (revocation) after submission in the event that a participant had a change of heart about taking part. The relationship of the poll to the current study's main research was also stated, as was an offer to share the findings of the poll given that a contact e-mail address was supplied.

It was expected that participants would naturally dis-count repeat visitors from their estimates of dimension prevalence although to do so was not made explicit to keep the preamble as brief and uncomplicated as possible. Space was provided near the end of the poll for participants to submit any comments about either the enquiry itself or about features of the poll. An invitation was also made to submit information about any additional attributes or characteristics of dyslexia-ness that were regularly encountered. Once participants had completed the poll, submitting it sent the dataset to the researcher's university e-mail account, where it was downloaded into an Excel spreadsheet for collation and analysis.

4. Results and Outcomes

Data received from the poll submissions were collated, and in the first instance the mean average prevalence for each dimension was calculated, derived from the average frequency (that is, extent) that each dimension was encountered (Table 3).

dim#	Dyslexia dimension	mean prev	st dev	95% CI for μ
8	students show evidence of having difficulty putting their writing ideas into a sensible order	75.7	14.75	70.33 < μ < 81.07
7	students say that when reading, they sometimes re-read the same line or miss out a line altogether	74.6	14.88	69.15 < μ < 79.98
10	students show evidence of poor short-term (and/or working) memory - for example, remembering telephone numbers	74.5	14.77	69.09 < μ < 79.84
18	students are very unwilling or show anxiety when asked to read 'out loud'	71.7	17.30	65.44 < μ < 78.03
3	students say that they can explain things more easily verbally than in their writing	70.6	15.75	64.84 < μ < 76.30
16	students report their tutors telling them that their essays or assignments are confusing to read	70.4	14.60	65.09 < μ < 75.71
2	students say that they find it very challenging to manage their time effectively	69.9	17.20	63.67 < μ < 76.19
17	students show evidence of difficulties in being systematic when searching for information or learning resources	64.3	19.48	57.21 < μ < 71.39
13	students show evidence of creative or innovative problem-solving capabilities	63.2	19.55	56.08 < μ < 70.32
4	students show evidence of being very disorganized most of the time	57.2	20.35	49.79 < μ < 64.61
12	when scoping out projects or planning their work, students express a preference for looking at the 'big picture' rather than focusing on details	57.1	18.00	50.58 < μ < 63.69
9	students show evidence of a preference for mindmaps or diagrams rather than making lists or bullet points when planning their work	56.7	17.44	50.32 < μ < 63.01
1	students' spelling is generally poor	52.9	21.02	45.22 < μ < 60.52
11	students say that they find following directions to get to places challenging or confusing	52.3	20.74	44.78 < μ < 59.88
14	students report difficulties making sense of lists of instructions	52.0	22.13	43.98 < μ < 60.09
15	students report regularly getting their 'lefts' and 'rights' mixed up	51.7	18.89	44.83 < μ < 58.57
5	in their writing, students say that they often use the wrong word for their intended meaning	47.8	20.06	40.46 < μ < 55.07
6	students seldom remember appointments and/or rarely arrive on time for them	35.7	19.95	28.41 < μ < 42.93

Table 3: Mean prevalence of dyslexia dimensions

24 participants reported additional attributes encountered in their work with dyslexic students, and where these were provided, most also included % prevalence:

- poor confidence in performing routine tasks [reported by 4 participants with prevalence respectively: 90%; 85%; 80%; % not reported (n/r)]
- slow reading [100%; 80%; n/r]
- low self-esteem [85%; 45%]
- anxiety related to academic achievement [80%; 60%]
- pronunciation difficulties / pronunciation of unfamiliar vocabulary [75%; 70%]
- finding the correct word when speaking [75%; 50%]
- difficulties taking notes and absorbing information simultaneously [75%; n/r]

- getting ideas from 'in my hear' to 'on the paper' [60%; n/r]
- trouble concentrating when listening [80%]
- difficulties proof-reading [80%]
- difficulties ordering thoughts [75%]
- difficulties remembering what they wanted to say [75%]
- poor grasp of a range of academic skills [75%]
- not being able to keep up with note-taking [75%]
- getting lost in lectures [75%]
- remembering what's been read [70%]
- difficulties choosing the correct word from a spellchecker [60%]
- meeting deadlines [60%]
- focusing on detail before looking at the 'big picture' [60%]
- difficulties writing a sentence that makes sense [50%]
- handwriting legibility [50%]
- being highly organized in deference to 'getting things done' [25%]
- having to re-read several times to understand meaning [n/r]
- profound lack of awareness of their own academic difficulties [n/r]

The additional attribute reported by the most participants (four) related to confidence, with slow reading being reported by three participants. Most other additional attributes were reported by only one participant.

5. Discussion

Although the response rate for this small-scale poll was disappointing, (30 participants out of 116 invitations to participate), it was considered that the data collected was sufficient to affirm that appropriate attributes of dyslexia had been selected which resonated with the typical field experience of dyslexia support professionals, and hence were reasonably representative of the profiles of dyslexic students at UK universities. Although an additional 24 attributes to the 18 provided in the poll were reported, most with a corresponding level of prevalence, the majority of these were reported by only one participant each, and hence were not considered indicative of a significant omission in the poll design. The additional attribute related to confidence was considered to be accounted for in the Academic Behavioural Confidence Scale, itself forming a major section of the main research questionnaire.

Hence, the 18 dyslexia dimensions were considered to have been validated to a sufficient degree by the outcomes of the poll to form the basis of the Dyslexia Index Profiler. In the first instance, these dimensions were formatted to be more concise; converted into the first person so that participants would feel engaged with the research; and re-phrased where necessary so that the Profiler would be relevant to all students. Secondly, the two additional dimensions relating to learning biography were now included (concerning letter reversal and slow uptake in learning to read). These did not form part of the validation poll as it was assumed that their context would be outside the frame of experience of the dyslexia tutors consulted.

The final iteration of the complete set of 20 dimensions that formed the Dx Profiler (Table 4), with weightings assigned as derived directly from the prevalence of

dimension #	*statement*	*weighting*
3.01	When I was learning to read at school, I often felt I was slower than others in my class	0.800
3.02	My spelling is generally very good	0.529
3.03	I find it very challenging to manage my time efficiently	0.699
3.04	I can explain things to people much more easily verbally than in my writing	0.706
3.05	I think I am a highly organized learner	0.572
3.06	In my writing I frequently use the wrong word for my intended meaning	0.478
3.07	I generally remember appointments and arrive on time	0.357
3.08	When I'm reading, I sometimes read the same line again or miss out a line altogether	0.746
3.09	I have difficulty putting my writing ideas into a sensible order	0.757
3.10	In my writing at school, I often mixed up similar letters like 'b' and 'd' or 'p' and 'q'	0.800
3.11	When I'm planning my work I use diagrams or mindmaps rather than lists or bullet points	0.567
3.12	I'm hopeless at remembering things like telephone numbers	0.754
3.13	I find following directions to get to places quite straightforward	0.523
3.14	I prefer looking at the 'big picture' rather than focusing on the details	0.571
3.15	My friends say I often think in unusual or creative ways to solve problems	0.632
3.16	I find it really challenging to make sense of a list of instructions	0.520
3.17	I get my 'lefts' and 'rights' easily mixed up	0.517
3.18	My tutors often tell me that my essays or assignments are confusing to read	0.704
3.19	I get in a muddle when I'm searching for learning resources or information	0.643
3.20	I get really anxious if I'm asked to read 'out loud'	0.717

Table 4: Weighting assigned to dyslexia dimension statements

dimensions established from the poll, were supplemented two additional dimensions were both assigned weightings of 0.61, this being the mean average weighting of the other 18 dimensions. This was considered reasonable given that no studies were found that were able to offer evidence of the prevalence of these dimensions in adults with dyslexia. The statements were ordered randomly to reduce the likelihood of order-effect bias. This is an error attributable to the sequence of questions or statements in a survey inducing a question-priming effect, such that a response provided for one statement or question subsequently influences the response for the following question, when these appear to be gauging the same or a similar aspect of the construct under scrutiny (McFarland, 1981).

6. Generating the Dyslexia Index (Dx)

Reverse coding

The objective of the Profiler was to generate a numerical output for every student participant - their Dyslexia Index (Dx) - and it was considered appropriate to aggregate the input-values of the Profiler in such a way that a high final Dx value indicates a high level of dyslexia-ness. However, as the Dx Profiler was designed to include a balance of positively and negatively phrased

statements (see sub-section 3.3/II), if dimension-statement values were aggregated without taking account of whether a high or a low value for any particular statement was a marker of a high level of dyslexia-ness, the Dyslexia Index value would be compromised. For example, for Dimension #2: 'My spelling is generally very good', it is reasonable to expect that a strongly dyslexic participant would be likely to disagree with this statement, and hence record a low value for this dimension. Whereas for Dimension #1, relating to slow uptake of early years basic reading skills, the same participant may be likely to record a high value, indicating strong agreement with the statement. Hence the value outputs for some statements needed to be reverse-coded to ensure that high values on all statements indicated high levels of dyslexia-ness.

As for identifying other dimensions that should be reverse-coded, this was a process that could only be achieved after data had been collected from participants in the research later. Several methods were trialled although after several iterations, the most likely outcomes were established by running a reliability analysis of the complete scale to generate Cronbach's α reliability coefficients. When these outputs were integrated into the dimension reduction techniques later in the data analysis, it was possible to verify that Dimensions #5, and #7 also required data reverse coding. The reliability analysis also identified some dimensions that may be redundant, leading to a reduced scale of 16 dimensions, which is reported below (sub-section 4.3/III/1). This aspect of the Dx Profiler requires developmental work and this may form the topic for a later project. However, in this current study, given the caveats mentioned, the process was considered robust enough to enable the outputs from the Profiler to be used.

Calculating Dyslexia Index (Dx)

The weighted mean calculation of the Dyslexia Index (Dx) using the raw scores (observed values) from a randomly chosen participant - a female, home, undergraduate who had declared dyslexia - has been used an example of the process (Table 5).

Research Participant #87564798				
Dim #	*Statement*	*observed value*	*weighting*	*weighted value*
1	When I was learning to read at school, I often felt I was slower than others in my class	77	0.800	61.600
2	My spelling is generally very good	70*	0.529	37.030
3	I find it very challenging to manage my time efficiently	66	0.699	46.134
4	I can explain things to people much more easily verbally than in my writing	83	0.706	58.598
5	I think I am a highly organized learner	17	0.572	9.724
6	In my writing I frequently use the wrong word for my intended meaning	66	0.478	31.548
7	I generally remember appointments and arrive on time	46	0.357	16.422
8	When I'm reading, I sometimes read the same line again or miss out a line altogether	100	0.746	74.600
9	I have difficulty putting my writing ideas into a sensible order	100	0.757	75.700
10	In my writing at school, I often mixed up similar letters like 'b' and 'd' or 'p' and 'q'	100	0.800	80.000

11	When I'm planning my work I use diagrams or mindmaps rather than lists or bullet points	33	0.567	18.711
12	I'm hopeless at remembering things like telephone numbers	83	0.754	62.582
13	I find following directions to get to places quite straightforward	40	0.523	20.920
14	I prefer looking at the 'big picture' rather than focusing on the details	70	0.571	39.970
15	My friends say I often think in unusual or creative ways to solve problems	78	0.632	49.296
16	I find it really challenging to make sense of a list of instructions	77	0.520	40.040
17	I get my 'lefts' and 'rights' easily mixed up	100	0.517	51.700
18	My tutors often tell me that my essays or assignments are confusing to read	61	0.704	42.944
19	I get in a muddle when I'm searching for learning resources or information	86	0.643	55.298
20	I get really anxious if I'm asked to read 'out loud'	98	0.717	70.266
			weighted mean:	74.895
	* reverse-coded value; participant recorded value = 30		Dyslexia Index:	748.95

Table 5: Example calculation of Dyslexia Index

The Dx output was scaled to a value between 0 and 1000 to more easily distinguish it from a participant's ABC value, derived directly from the unscaled, unweighted mean average of the 24 statements of the ABC Scale, each gauged in the range 0 to 100.

7. Concluding summary

In summary, the Dx Profiler calculated a Dyslexia Index for each respondent in the research datapool, being a weighted mean average of responses to 20 Likert-style item statements, where each aimed to capture data relating to a specific study attribute or behaviour, or an aspect of learning biography. Respondents recorded their strength of agreement with each statement along a continuous range from 0% to 100%. Weightings were derived from the prevalence of characteristics determined through a poll of dyslexia support practitioners. The weighted mean was scaled to provide an output, Dyslexia Index (Dx), in the range $0 < Dx < 1000$. With data available following deployment of the main research questionnaire, dimensionality reduction was applied (PCA) to explore the factor structure of the Dx Profiler. This was firstly to compare the output with the speculated structure based on the BDA definition of dyslexia, and secondly to determine whether a useful cross-factorial analysis might be conducted with outputs from the ABC Scale. The aim was to explore more thoroughly the associations revealed between academic confidence and dyslexia-ness (reported in sub-section 4.6). This analysis remains tentative and to an extent, speculative, because the size of the sample (n=98) from which it was generated is quite small. A later study could aim to develop the Dx Profiler by collecting data from larger and more varied samples, hence enabling PCA to be more confidently applied.

The outcome of the development process was that the Dx Profiler was considered to have met its design specifications and was used confidently to gauge the dyslexia-ness of the participants in the study, and hence was included as the final section of the research questionnaire.

4 Results and Analysis

4.1 Overview

I Objectives

The objectives of the analysis were to enable the research hypotheses (Section 1.4) to be addressed: firstly, by comparing ABC data from the groups of dyslexic and non-dyslexic students; secondly, by comparing ABC data from the dyslexic students of the Control subgroup with the non-dyslexic students in the Base subgroup; finally, ABC data for the quasi-dyslexic students of the Test subgroup were compared with those in the Control subgroup.

II ANALYSING QUANTITATIVE DATA - RATIONALES:

1. INTERNAL CONSISTENCY (RELIABILITY) - CRONBACH'S 'ALPHA' (α)

Both the metrics in this study gauged constructs that used linear scales. The existing, ABC Scale operationalized academic confidence, and the Dyslexia Index Profiler was developed especially for this study to assess participants' levels of dyslexia-ness. Each scale comprised multiple dimensions, collectively designed to assess their respective underlying construct. In order to have confidence that the data generated was meaningful, it was important to assess the reliability and validity of the scales. Cronbach's α coefficient of internal reliability is typically used in social science research, notably in psychology (Lund & Lund 2018). An α value within the range $0.3 < \alpha < 0.7$ is considered as acceptable with preferred values being closest to the upper limit (Kline, 1986). On this basis, precedents have shown acceptable levels of internal reliability for the ABC Scale, determined by Cronbach's $\alpha > 0.7$, (Putwain & Sanders, 2016; Shaukat & Bashir, 2015; Nicholson et.al., 2013; Aguila Ochoa & Sander, 2012; Sander & Sanders, 2009; Sanders & Sander, 2007). Clearly, as the Dx Profiler has been developed for this current study, no prior measures of the scale's internal reliability or validity are available.

However, several features of the α coefficient assessment imply that outputs derived from using it to gauge a scale's internal reliability should be considered tentatively. In the first instance, excessively high levels of α (i.e. > 0.9) may indicate scale-item redundancy, that is, where some items (dimensions) are measuring very similar traits (Streiner, 2003; Panayides, 2013). There is a lack of agreement, however, about which level of α should be chosen as the critical value for this interpretation, with $\alpha > 0.7$ frequently considered as the popular 'rule of thumb' (e.g.: Morera & Stokes, 2016). This is despite (computational) evidence that a scale with more items, supposedly gauging the same underlying dimension, will naturally increase the value of α (Cortina, 1993; Nunnally & Bernstein, 1994; Tavakol & Dennick, 2011). Secondly, it is important to note that Cronbach's α tests the consistency of responses within a datapool as opposed to the reliability of the scale per se, and therefore is attributable to a specific use of the scale (Streiner, 2003; Boyle, 2015; Louangrath, 2018). Thirdly, and especially when used in conjunction with dimension reduction techniques, it is reasonable to suppose that the factors which emerge from such a reduction (the sub-scales) should also be evaluated for their reliability, and these outcomes cited together with the α value for the complete scale.

Frameworks have been suggested for improved reporting and interpretation of internal consistency estimates that may present a more comprehensive picture of the reliability of data collection procedures, particularly data elicited through self-report questionnaires. In particular, and consistent with the approach adopted in this current study for reporting effect size differences (see sub-section 4.1/II.2, below), reporting an estimate for a confidence interval for α in addition to the single-point value, noting particularly the upper-tail limit is considered to be one improvement

(Onwuegbuzie and Daniel, 2002). The idea of providing a confidence interval for Cronbach's α is attractive because the value of the coefficient is only a point estimate of the likely internal consistency of the scale (and hence the construct of interest). Interval estimates are stronger, not least as the point estimate value, α, is claimed by Cronbach in his original (1951) paper to be most likely a lower-bound estimate of score consistency. This implies that the traditionally calculated and reported single value of α is likely to be an under-estimate of the true internal consistency of the scale were it possible to apply the process to the background population. Hence the upper-limit confidence interval can be reported in addition to the point-value of Cronbach's α because this is likely to be a more generalizable report about the internal consistency of the scale.

This principle is adopted in this current study, with confidence intervals calculated using Fisher's (1915) transformation which maps the Pearson Product-Moment Correlation Coefficient, r, (upon which Cronbach's α) is derived) on to a value, Z', which was shown to be approximately normally distributed and hence, confidence interval estimates could be constructed. Therefore, it follows that Fisher's Z' can be used to transform Cronbach's α and subsequently create confidence interval estimates for α. This process enabled a more complete reporting of the internal consistency of the ABC Scale, the Dx Profiler, and their respective sub-scales (identified through dimension reduction) for the datapool, and for each of the research groups, ND, DI (sub-section 4.3/III.1; /IV.1).

2. Effect sizes

Effect size measures were used as the principal statistical evidence in this study. Effect size challenges the traditional convention that the *p*-value is the most important data analysis outcome response to determine whether an observed effect is real or should be attributed to chance events (Maher et al., 2013). Effect size values are a measure of either the magnitude of associations or the magnitude of differences, depending on the nature of the data sets being analysed. Effect size is an absolute value measure (as opposed to the significance) of an observed effect (Cumming 2012), and provides a generally interpretable, quantitative statement about the magnitude of a difference in [or association between] observations (Fritz, et.al., 2012). When clearly defined in a study's methodology, and reported together with their respective confidence intervals, effect sizes provide an improved way to interpret data (Ferguson, 2016). Effect size is easy to calculate, and when used to gauge the between-groups difference between means, effect size is generally reported as Cohen's *d* (Cohen, 1988). If the groups being compared have dissimlar sample sizes (as in the current study), the unbiased estimate of *d* is used (i.e, Hedges' *g,* (Hedges, 1981)), calculated using the weighted, pooled standard deviations of the datasets. Effect size is increasingly prevalent in quantitative analysis (Gliner, et.al., 2001; Sullivan & Feinn, 2012; Carson, 2012; Maher, et.al., 2013), and is particularly useful when observed measurements have no intrinsic meaning, such as with data formulated from Likert-style scales (Sullivan & Feinn, 2012). The use of effect size as a method for reporting statistically important analysis outcomes is especially gaining traction in education, social science and psychology research (Kelley & Preacher, 2012; Rollins, et al., 2019), not least in studies about dyslexia, where it is claimed to be a vital statistic for quantifying intervention outcomes designed to assist struggling readers (ibid).

3. Null-hypothesis significance testing (NHST); ANOVA

Notwithstanding (2) above, the effect size data analyses were supported by measures of the statistical significance of the difference between independent sample means, determined through Student's t-test outcomes, to acknowledge the continued value of null-hypothesis significance tests in social science research. Thus, when taken together with effect sizes and their confidence intervals, comprehensive and pragmatic interpretation of the experimental outcomes could be discussed. One-tail t-tests were conducted in accordance with the alternative hypotheses stated (sub-section 1.4). Homogeneity of variance was established using Levene's Test, and according to the output, the appropriate *p*-value was taken, with the conventional 5% level being adopted as the significance boundary value. It is recognized that the application of ANOVA to this data may have been appropriate had dyslexia-ness been categorized into 'high', 'moderate', 'low', or other sub-gradations, that is, that the independent variable was categorical in nature (Moore & McCabe, 1999; Lund & Lund, 2016). However, the Student's t-test was regarded as a better choice because it is easier to interpret, commonly used, and appropriate when the independent variable (in this case, Dyslexia Index), is continuous in nature (ibid).

4. Dimension reduction

These statistical processes outlined so far proved sufficient to address the research hypotheses. However, dimension reduction by principal components analysis (PCA) was applied later as a secondary process to determine whether meaningful factor structures could be established for both the ABC Scale and the Dyslexia Index metric. The original objective was to explore the influences of groups of similar dimensions of dyslexia-ness (Dx factors) on academic confidence to search for more nuanced explanations for differences in ABC, although in the light of PCA outcomes for the Dx Profiler, this was later modified (see sub-section 4.5/III&IV).

The PCA process is said to be useful to explore whether a multi-item scale that is attempting to evaluate a construct can be reduced into a simpler structure with fewer components (Kline, 1994, Kanyongo, 2005), although there remains considerable debate about how to best to identify the most appropriate number of factors to retain from those which emerge from dimension reduction (e.g.: Velicer, et.al, 2000). As a precedent, Sander and Sanders (2003) recognized that dimension reduction may be appropriate for their original, 24-item ABC Scale. Their procedure generated a 6-factor structure, the components of which were designated as Grades, Studying, Verbalizing, Attendance, Understanding, and Requesting. By combining datasets from their earlier studies, a subsequent analysis found that the ABC Scale could be reduced to 17 items with 4 factors, designated as Grades, Verbalizing, Studying and Attendance (Sander & Sanders, 2009). The remaining dimensions of the reduced, 17-item ABC Scale were unamended. Hence, retaining the the full, 24-item scale in this current study enabled dimension reduction to be applied to consider whether a meaningful, local sub-scale structure was likely. It was also possible to calculate alternative 17-item overall mean ABC values simultaneously so that both sets of results were available to consider against the research hypotheses.

Just as Cronbach's α can offer a measure of internal consistency to a local construct scale (and identify scale item redundancy), factor analysis is ascribable to the dataset onto which it is applied. It was considered therefore that the Sander and Sanders factor structures may not be the most appropriate for the data in this current study, despite being widely used by other researchers in one form (ABC24-6) or the other (ABC17-4) (e.g.: de la Fuente et al., 2013; de la Fuente et al.,

2014; Hilale & Alexander, 2009; Ochoa et al., 2012; Willis, 2010; Keinhuis et al., 2011; Lynch & Webber, 2011; Shaukat & Bashir, 2016). Indeed when reviewing the ABC Scale, Stankov et.al., (in Boyle et.al., 2015) implied that more work should be done to consolidate some aspects of the ABC Scale, not so much by levelling criticism at its construction or theoretical underpinnings, but more to suggest that as a relatively new measure (> 2003) it would benefit from wider applications in the field, and subsequent scrutiny about how it is built and what it is attempting to measure. In the event, only one study was found (Corkery et.al., 2011) which appeared to share this cautious approach for adopting the ABC Scale per se, choosing instead to conduct a local factor analysis to determine the structure of the Scale according to their data, setting a single precedent for taking the same course of action in this current study.

However, it also remained unclear from the Sander and Sanders original, and subsequent studies, whether the components analyses adopted for both the individual and the later, combined datasets, were compared with a factor structure that may have been just as likely to have occurred by chance. Indeed, from the body of literature examined where the ABC Scale has been used either as the principal metric or as an additional aspect of the analysis processes, no studies' data analyses appear to suggest that any comparisons with a factor structure which may have occurred randomly were conducted. Common practice to determine the number of factors to retain in these, and in numerous other studies where component analysis has been applied, use either a visual inspection of the scree plot of eigenvalues against components (Cattell, 1996; Horn & Engstrom, 1979) looking for the point where the slope changes markedly as a means to determine the number of components to declare; or otherwise choose components which present initial eigenvalues > 1 in the table of total variance explained, as those to be included in the final factor structure (Kaiser, 1960). Both processes are not without their difficulties: In the first instance, determining the the number of components to include from visual inspection of the scree plot relies on subjective judgement (e.g.: Zwick & Velicer, 1982), despite common convention; and when relying on eigenvalues > 1 in the table of total variance explained, when no clear distinction exists between two (or more) components that are very close to this critical value, it becomes difficult to decide which components to include and which to omit.

In this current study, early iterations of the process suggested that solutions of four, five, or six factors for both ABC and for Dx could be reasonably supported, determined from both the eigenvalues > 1, and visual interpretations of the scree plots criteria. In the event, five-factor solutions for both variables were initially adopted, based on realistically determining outcomes that could lead to a meaningful interpretation of the data. However, a parallel analysis of multiple randomized versions of the raw data (Eigenvalue Monte Carlo Simulations) was subsequently conducted to examine a factor structure that could have emerged by chance, to consider against the initial iterations of the PCA applied to the ABC and Dx Scales. This was conducted in SPSS according to the guidance provided by O'Connor (2000), and also served to take account of the likelihood of assumption violations unduly influencing solutions for retaining factors (Hutchinson & Bandalos, 1997; Kanyongo, 2005). This later re-analysis of the data suggested that a three-factor solution may be a better model (sub-section 4.5). Whilst outcomes for the ABC Scale were robust, dimension reduction results for the Dx Profiler Scales were inconclusive and thus, speculative. It is possible, if not likely, that this could be because the metric was developed especially for this current study, and hence, only the 166 datasets collected from participants were available.

Precedents for dimension reduction processes (i.e. for the ABC Scale), suggest that combining similar-source datasets from several studies is likely to increase confidence in the robustness of sub-scales that emerge, eventually leading to a more standardized scale and sub-scales which can be applied confidently to individual studies. Thus, application of the process to determine a possible sub-scale structure for the Dx Profiler would benefit from additional data from other studies before outcomes can be meaningful. Hence, it was considered that a more nuanced, factorial analysis of the ABC data collected in this study could be confidently conducted. However, to apply unstable Dx Profiler factors to sub-divide outcomes further was considered unwise, and may lead to conclusions of dubious worth, not least due to the small sample sizes of the data subgroups. Development of this aspect of the enquiry will be a topic for subsequent study.

5. Multiple Regression Analysis

Finally, a tentative multiple regression analysis was conducted to add an additional perspective to the statistical evidence generated thus far to address the research hypotheses. Precedents suggest that multi-variable regression analysis can be valuable in dyslexia research to add substance to the rationales which underpin the multi-factorial approaches to understanding dyslexia (sub-section 2.1(II/6)). Hence regression analysis was considered to have value in this current study where the objective was to examine differences between observed and expected ABC outcomes according to Dx inputs, rather than to suggest predictive models for indicating levels of ABC based on Dyslexia Index. The purpose was to use the generated regression equations to determine whether quasi-dyslexic students return higher than expected levels of ABC than their dyslexia-identified peers.

III Analysing Qualitative Data - Rationales

Qualitative data were not formally analysed, instead, elements of these data were used to elaborate the discussion element of the thesis (see Section 5). However, the principles for applying an Interpretative Phenomenological Analysis (IPA) to these data were considered, as IPA is typically used to explore, interpret and understand a phenomenon in people - dyslexia in students in this current study - from the perspectives of the lived-experiences of the individuals of interest (Reid et al., 2005). But an IPA approach was deferred for three reasons: firstly, understanding how students with dyslexia make sense of their learning and study experiences at university and how they attach meaning to the life events that occur in this context (e.g.: Smith et al., 2009) was not the main focus of the research. Instead, the research aim was quite specific, that is, to use the dyslexia-ness continuum approach to examine how dyslexia-ness impacts on academic confidence. Secondly, these (qualitative) data were only acquired from students in the dyslexic group. This was not by design, merely that no participants in the non-dyslexic group provided any data in this form. Hence it was considered that formal, qualitative analysis would have been skewed, and not generalizable across the datapool. Lastly, although IPA attempts to uncover themes in qualitative data, it is conventionally conducted with small, purposive samples of typically fewer than ten participants (Hefferon & Gil-Rodriguez, 2011), with analysis being overly descriptive rather than more deeply interpretative (ibid). In this study, the qualitative data were drawn from a moderately large dataset (n=68) rather than by selecting a small, representative sample. Hence, although some elements of IPA are utilized, for example in identifying thematic narratives, these are used to support the quantitative outcomes of the data

analysis, the formal process was not adopted. That said, the data provided an extensive representation of the challenges and difficulties faced by dyslexic students at university, and hence may be used in a more focused study later.

4.2 TERMINOLOGY

Refer to the List of Abbreviations for the meanings of labels, terms, acronyms and designations used in the reporting and discussion of the data, results and analysis.

4.3 RESULTS

I DEMOGRAPHICS

A total of n=183 questionnaires were returned. Seventeen were discarded due to Dx Profiler data less than 50% complete and so to determine these individuals' Dyslexia Index was considered unrealistic.

The demographic distribution of the datapool according to dyslexia status, gender, home residency, and study level is shown in Table 6. The equivalent distributions for the Test and the Base subgroups, which were both subsets of the non-dyslexic students' group; and for the Control subgroup, which was a subset of the dyslexic students' group, are presented in Table 7.

DISTRIBUTION BY GENDER

Overall, female participants (n=113, 68%) outnumbered male participants (n=53, 32%) by a factor of approximately 2 to 1. Amongst the dyslexic participants, females (n=53, 78%) outnumbered males (n=15, 22%) by more than 3 to 1. Of students recruited through the open invitation to all students, and who subsequently formed research group ND (n=98), the distribution by gender showed females (n=60, 61%) substantially outnumbered males (n=38) (39%).

DISTRIBUTION BY DOMICILE

Participants were asked to declare whether they were a 'home/UK' or an 'international/overseas' student. The majority of students in both groups were from the UK (dyslexic participants: 96%, non-dyslexic participants: 73%).

DISTRIBUTION BY STUDY LEVEL

Data about level of study were collected to determine whether the datapool represented a reasonable cross-sectional match to student communities attending UK universities more generally. Although a wider selection was available in the questionnaire for participants to choose the level of study which most closely matched their own, these data were grouped as either study at up to, and including level 6 (equivalent to final-year undergraduate), or higher than level 6. Those participants who indicated study for professional or vocational qualifications were grouped with post-graduates, and that to be consistent with national levels, those studying at Foundation/Access level also included those studying at pre-level 4 (pre-1st year undergraduate). National data for 2016/17 (HESA, 2018) showed that 54% of the UK student population were undergraduates, 12% were attending Foundation or Access courses, 31% were studying on post-graduate taught programmes and 3% were post-graduate researchers. Hence, where study at level 6 or lower accounted for 66% of the student population nationally, undergraduate respondents in this study (n=124, 75%) are slightly over-represented, and that the proportion studying at post-graduate level is under-represented (n=42, 25%).

Datapool	Dyslexia status		Home domicile		Gender		Study level‡	
	Dyslexic	Non-Dyslexic	UK	Non-UK	M	F	≤ L6	> L6
166	68	-	65	-	15	-	9	5*
					-	50	42	7*
			-	3	0	-	0	0
					-	3	0	3
	-	98	72	-	29	-	23	6
						43	34	8†
			-	26	9	-	8	1
					-	17	8	9
subtotals	68	98	137	29	53	113	124	39 (42, see notes)
totals	166		166		166		166	

Table 6: Demographic distribution of the datapool by dyslexia status, home domicile, gender and study level

‡ Study level according to the Regulated Qualifications Framework for England and Wales (Ofqual, 2015) * +1 respondent study level not disclosed; † +1 studying for Professional or Vocational qualification

Research Group	Research Subgroup		Home domicile		Gender		Study level‡	
ND	Test	Base	UK	Non-UK	M	F	≤ L6	> L6
98	18	-	16	-	9	-	6	3
					-	7	4	3
			-	2	0	-	0	0
					-	2	1	1
	check totals:		*18*		*18*		*18*	
	-	44	27	-	12	-	10	2
					-	15	10	5
			-	17	4	-	3	1
					-	13	7	6
	check totals		*44*		*44*		*44*	
			36		*36*		*36*	
DI	Control	-						
68	47	-	44	-	10	-	7	3
					-	34	26	8
			-	3	0	-	0	0
					-	3	0	3
	check totals		*47*		*47*		*47*	
	residue (400 < Dx < Test/Control))		*21*		*21*		*21*	
datapool			*166*		*166*		*166*	

Table 7: Demographic distribution of Test, Base and Control research subgroups by home domicile, gender and study level

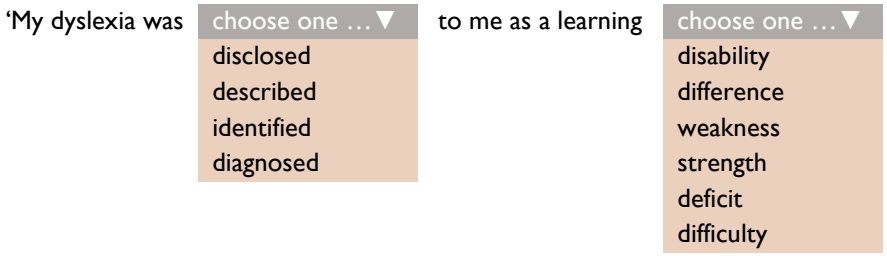
‡ Study level according to the Regulated Qualifications Framework for England and Wales (Ofqual, 2015)

II How students with dyslexia learned of their dyslexia

The impact of a diagnosis of dyslexia on Academic Behavioural Confidence

This study's hypotheses were grounded on the premise that the dyslexia label may be one of the contributing factors to reduced ABC in students with dyslexia, and which may be especially likely when this label emerged from diagnosing dyslexia as a disability (see Section 2.1/IV). Thus, one aspect of the enquiry formulated an hypothesis to explore how dyslexic students were told about their dyslexia (Section 1.4).

Participants in this current study who declared their dyslexia were invited to report how they were informed about their dyslexia by selecting options to complete a simple statement (Figure 13).



It was reasonable to assume that the 68 students who declared their dyslexia had participated in a formal dyslexia screening and/or assessment at university, or during their earlier years in

Figure 13: Option-selection sentence to indicate how students learned of their dyslexia

education, and 64/68 (94%) provided data (Table 8). Of these 64, 22 (34%) said that their dyslexia was diagnosed to them as a disability; 18 (28%) said that their dyslexia was diagnosed to them as a difficulty, while 1 student (1.5%) said that their dyslexia was diagnosed as a deficit; 23 students (36%) learned of their dyslexia by one of the other alternatives offered, with 3/23 (< 2%) having their dyslexia described or identified as a difference. Of the 4 students with dyslexia who did not respond, it is not known whether this was due to a reluctance to disclose, or that an option that matched their recollection about how they learned of their dyslexia was not available.

	[disability]	[difference]	[weakness]	[strength]	[deficit]	[difficulty]	∑
[disclosed]	1	0	0	0	0	2	3
[described]	2	1	0	0	0	5	8
identified]	5	2	0	0	1	4	12

[diagnosed]	22	0	0	0	1	18	41
totals	30	3	0	0	2	29	64

Table 8: Summary of dyslexia self-report sentence: 'My dyslexia was […] to me as a learning […]'

The 64 datasets were sorted into three subgroups: those whose dyslexia was diagnosed as a disability (subgroup DS); those whose dyslexia was diagnosed to them as a difficulty (subgroup DF); leaving the remainder to be aggregated into a third subgroup E.

The full, 24-item ABC Scale was used, and mean average values were calculated both overall, and for each of the three ABC24 Factors (determined through PCA (see below, sub-section 4.5/II) was calculated for each subgroup and also for subgroups DS and DF combined. Unbiased effect size differences (Hedges '*g*') were calculated, supported by *t*-test outcomes. In accordance with the hypotheses, one-tail tests were applied at the 5% significance level. Levene's Test for homogeneity of variances was applied and where violated, the outcome for unequal populations variances is reported. (see Table 10).

Moderate to large effect size differences in mean ABC24-overall values are indicated between subgroup E, and subgroups DF, DS, and DF+DS combined (g=0.704, 0.627, 0.639 respectively); these are supported by *t*-test outcomes indicating significant differences between mean values in all cases. Hence, students whose dyslexia was diagnosed as a disability or as a difficulty (or either), returned significantly lower overall ABC24 mean values when compared with students who were told of their dyslexia in any of the alternative ways. Thus, the null hypothesis is rejected in favour of each of the alternatives, respectively.

At a more granular level, examining the outcomes for differences in ABC24 at a factorial level revealed moderate, or moderate to large effect sizes between mean ABC24 factor values for each of the three subgroup comparisons, and although these were not universally supported by significant differences in means, most t-test outcomes were significant or marginal (Table 9).

(sample size)	'My dyslexia was […] to me as a learning […]'		ABC24 Overall	ABC24 Factor 1: Study Efficacy	ABC24 Factor 2: Engagement	ABC24 Factor 3: Organization & Planning
subgroup E(15)	[disclosed / described / identified]	[difference / difficulty]	66.59	68.78	58.49	74.52
subgroup DF(19)	[diagnosed]	[difficulty]	55.44	57.72	48.85	61.30
subgroup DS(22)	[diagnosed]	[disability]	58.26	61.06	51.37	63.91
subgroup DS+DF(41)	[diagnosed]	[disability / difficulty]	56.95	59.52	50.20	62.70
comparing:	subgroup E against subgroup DF	effect size: Hedges g	0.7040	0.4667	0.4906	0.6708
		t-test	t(31) = 2.14 p = 0.02	t(32) = 1.70 p = 0.05 (0.0491)	t(32) = 1.51 p = 0.07	t(35) = 2.12 p = 0.02
	subgroup E against subgroup DS	g	0.6268	0.3828	0.3969	0.6180
		t-test	t(33) = 1.93 p = 0.03	t(32) = 1.34 p = 0.09	t(30) = 1.25 p = 0.11	t(35) = 2.12 p = 0.02
	subgroup E against subgroup DF+DS	g	0.6394	0.4924	0.4598	0.6231
		t-test	t(33) = 2.42 p = 0.01	t(29) = 1.77 p = 0.04	t(27) = 1.58 p = 0.06	t(44) = 2.65 p < 0.01

† homogeneity of variances violated (Levene's Test)

Table 9: Comparing ABC mean values of dyslexic students according to how they learned of their dyslexia

III THE DYSLEXIA INDEX PROFILER

I INTERNAL RELIABILITY OF THE DX PROFILER - THE DX20 AND DX16 SCALES

The Dx Profiler was at first, a 20-item scale, later found to have a possible, 3-factor, sub-scale structure (see Section 4.5). The levels of internal reliability of the scale and of the sub-scales were assessed using the Cronbachs's α criterion. According to the conventional interpretation of α values (see sub-section 4.1/II.1), the Dx Profiler overall, together with each of the sub-scales, presented acceptable levels of internal reliability for examining the datasets in this datapool, although there was some concern about the low levels of reliability of the Factor 3 sub-scale in comparison to both the other factors and to the scale overall. Later evidence from dimension reduction analysis confirmed the unstable nature of the 3-factor sub-scale structure for the Dx Profiler, as based on only the data in this current study (see sub-section 4.5/III).

Furthermore, the reliability analysis also suggested that some dimensions in the 20-item scale may be redundant by contributing minimally to the overall Dyslexia Index value for each respondent - considered as possible, additional evidence of uncertainty about a sub-scale structure for the metric. Interpretation of the matrix of correlation coefficients (not shown) to identify pairs of dimensions that showed a correlation of $r > 0.7$, enabled each of the potentially redundant dimensions to be eliminated in turn and in permutations, to permit corresponding re-runs of the reliability analysis. Several iterations of this process subsequently enabled similar, acceptable levels of reliability to be established by reducing the 20-item scale to 16 items. The α coefficients for both scales were calculated for the datapool and also for the two primary research groups. The 95% upper boundary of confidence intervals for α are also provided [~, upper boundary] (Table 10).

Scale	Sample	α, complete scale	α, Factor 1	α, Factor 2	α, Factor 3
Dx20	datapool	0.849 [~,0.887]	0.875 [~,0.907]	0.617 [~,0.703]	0.481 [~,0.590]
	ND	0.850 [~,0.897]	0.879 [~,0.917]	0.498 [~,0.634]	0.569 [~,0.690]
	DI	0.723 [~,0.820]	0.740 [~,0.832]	0.370 [~,0.559]	0.666 [~,0.780]
Dx16	datapool	0.887 [~,0.916]	0.841 [~,0.881]	0.802 [~,0.850]	0.441 [~,0.556]
	ND	0.869 [~,0.882]	0.829 [~,0.882]	0.795 [~,0.858]	0.401 [~,0.555]
	DI	0.762 [~,0.847]	0.637 [~,0.760]	0.659 [~,0.776]	0.442 [~,0.616]

Table 10: Cronbach's α reliability coefficients for the Dx20 and Dx16 scales.

The α value for the 16-item scale exceeded that for the 20-item scale for the datapool and also for the dyslexic and non-dyslexic groups, although the α values for both versions of the scale were within 0.04 of each other for the datapool and for both groups respectively. Hence it was reasonable to assume that either scale, or indeed, both, were likely to be providing reliable indicators of dyslexia-ness amongst the respondents in this datapool. Note that the dataset composition of the three comparison subgroups (Base, Test, and Control), showed slight variations depending on whether the Dx20 or Dx16 scales were used to calculate Dx values. These differences impacted slightly on the corresponding ABC outcomes (see Section 4.4).

The four scale items that were identified as redundant from the 20-item Dx scale were:

- Dx 03: ‘I find it very challenging to manage my time efficiently;
- Dx 05: ‘I think I am a highly organized learner’;
- Dx 07: ‘I generally remember appointments and arrive on time’;
- Dx 13: ‘I find following directions to get to places quite straightforward’.

These dimensions had been identified at an earlier stage of the data collation process as potentially troublesome, demonstrated by a wide disparity in Dx dimension values across the datapool which appeared to be independent of students' dyslexia status. A cursory scale-reliability analysis of these four dimensions taken together indicated them to be unlikely to comprise a unique factor scale (further supported by the dimension reduction analysis of the Dyslexia Index metric later - see 4.5/III). Dimension Dx13 was identified as the most disruptive of these four dimensions by examining the impact of removing this only dimension on scale reliability. However, this led to more confused, rather than clearer picture, suggesting that a more stable scale could be established by removing all four redundant dimensions.

Examining scale reliability was an important part of the development process for the Dyslexia Index Profiler although the emergence of two scales, Dx20 and Dx16, led to a more complex analysis of ABC outcomes later (see sub-section 4.5 below). In the absence of more data being available to verify which version of the metric is likely to be the more precise gauge of dyslexia-ness, both were retained for the reporting of results.

II Dx Profiler distributions and basic statistics

Visual inspections of both distributions indicated them to be approximately normal by broadly exhibiting the characteristic bell-shaped outline (see Figure 14), although the distribution for the non-dyslexic group presented elements of bimodality. This was an anticipated outcome, confirming the likelihood of the quasi-dyslexic subgroup. Nevertheless, the Shapiro-Wilks test ($p>0.05$) indicated normality in both distributions according to conventional interpretations, which was further supported by examination of Q-Q plots (Figure 16 (Dx20 plots shown)) where the datapoints for each group are generally positioned approximately along the diagonal. There were no outliers in either distribution, determined by examination of the respective box-plots and application of the +/- three standard deviations criteria (Lund & Lund, 2018).

Marked differences were seen between Dx values for the two groups where both the sample mean Dx and median Dx are much lower for the non-dyslexic students using either scale (Table 12). For the Dx20 scale, a very large effect size of g = 1.34 [95% CI: 1.00, 1.68] (Sullivan & Feinn, 2012) between the Dx sample means was supported by an NHST outcome indicating a significantly lower mean Dx for students with dyslexia ($t(161) = 8.81$, $p<0.001$), assuming unequal population variances as indicated by violation of Levene’s test for homogeneity of variances ($F(164) = 7.65$, $p=0.006$).

Outcomes from the reduced item Dx16 scale were similar (Table 11), although a wider Dx range for the non-dyslexic group using this version of the metric, together with greater differences in the measures of central tendency between the two groups, may be indicating that better discriminative granularity was demonstrated with this version of the scale. Interpretations of outcomes from both scales suggest that the Dx Profiler is returning the expected, high Dx values for the majority of students who declared their dyslexia, and a much lower value for the substantial proportion of those who declared no dyslexic learning challenges, with these marked differences being clearly visible when the distributions were plotted on the Dyslexia-ness Continuum (Figure 15).

Scale	Research Group	n	Dx range	sample mean Dx	95% CI for μ	median Dx
Dx20	ND	98	32 < Dx < 888	430	393 < Dx < 466	398
	DI	68	326 < Dx < 960	670	635 < Dx < 706	700
			Hedges *g*:	1.44		
			t-test outcome:	t(160) = 9.29; p < 0.001		
Dx16	ND	98	81 < Dx < 831	446	414 < Dx < 479	425
	DI	68	349 < Dx < 933	646	615 < Dx < 677	661
			Hedges *g*:	1.34		
			t-test outcome:	t(161) = 8.81; p < 0.001		

Table 11. Dyslexia Index summary according to research group.

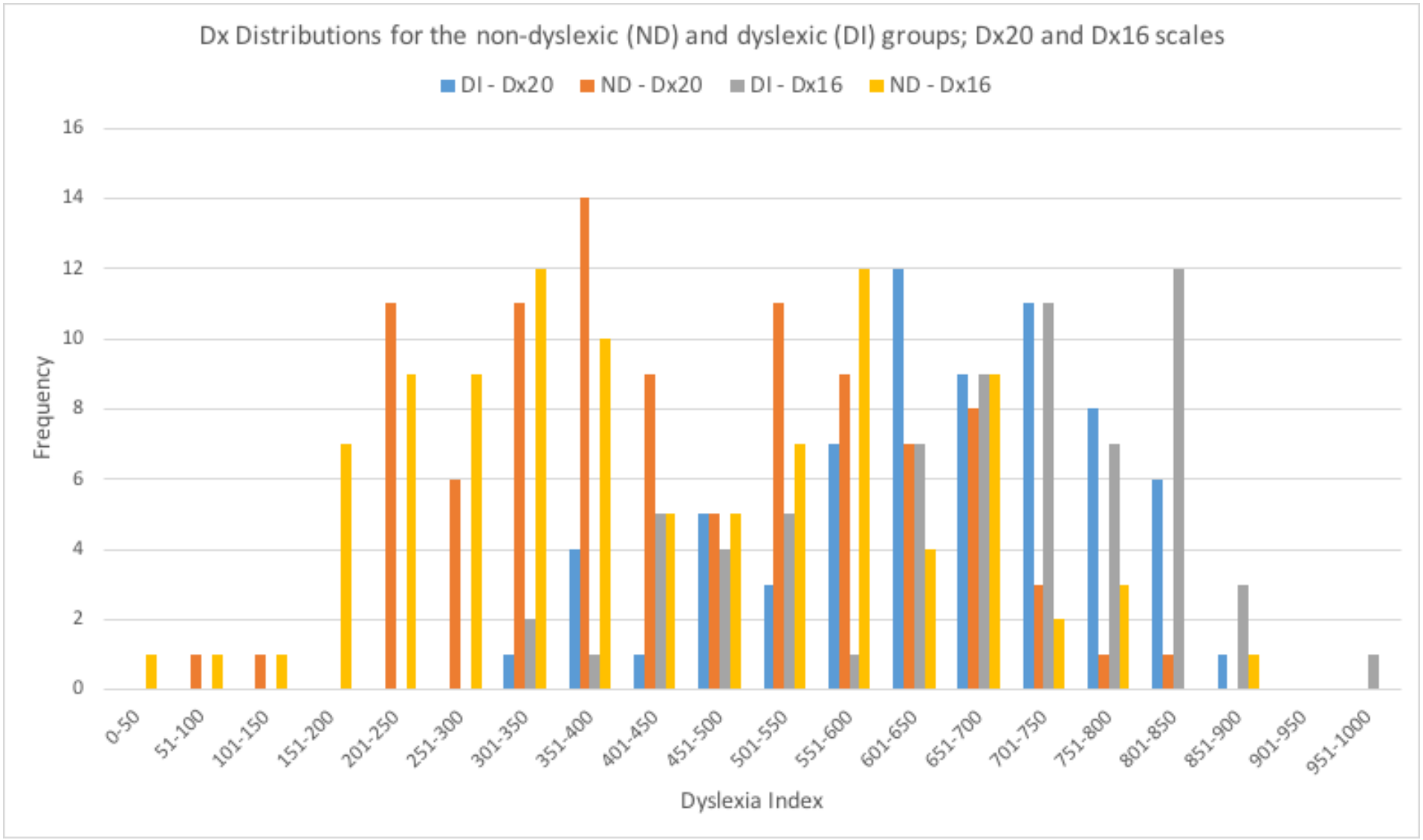


Figure 14: Distributions of Dyslexia Index for the Non-Dyslexic, (RG:ND), and the Dyslexic (RG:DI), groups.

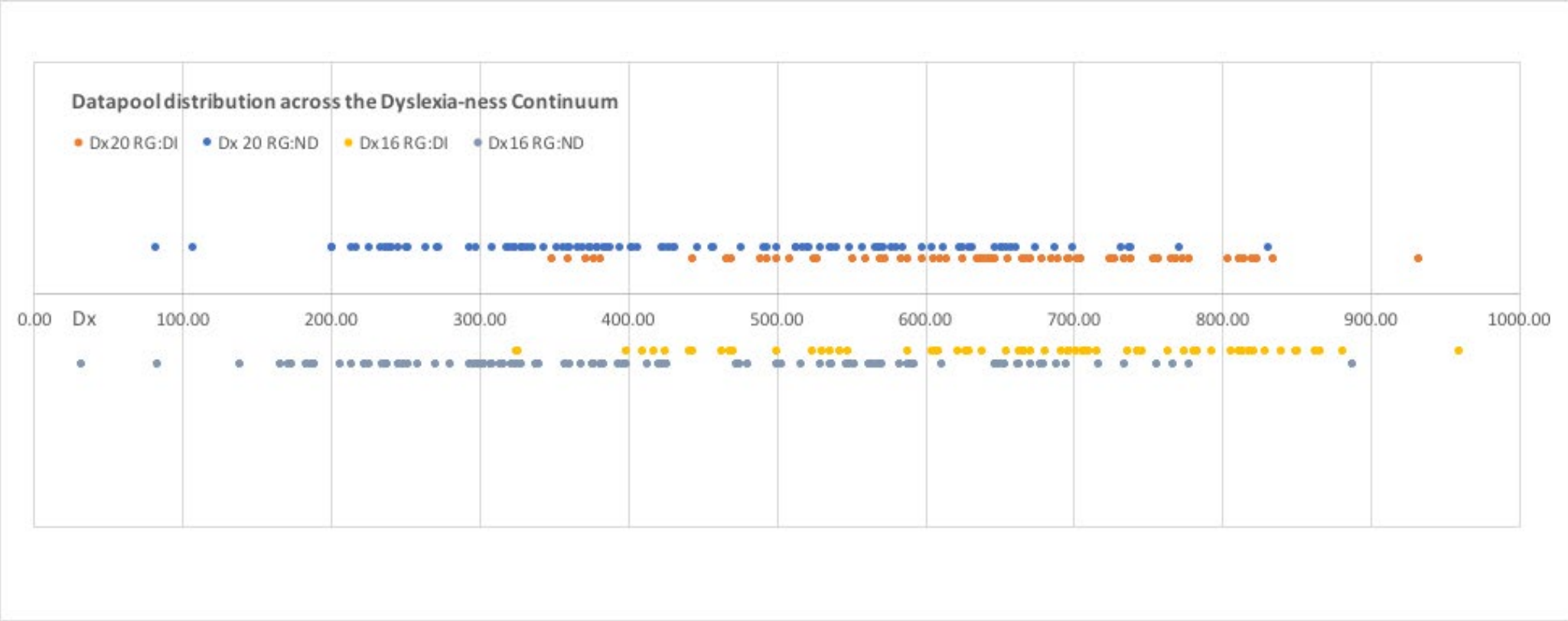


Figure 15. Research groups located on the Dyslexia-ness Continuum using the Dx20, and Dx16 sca

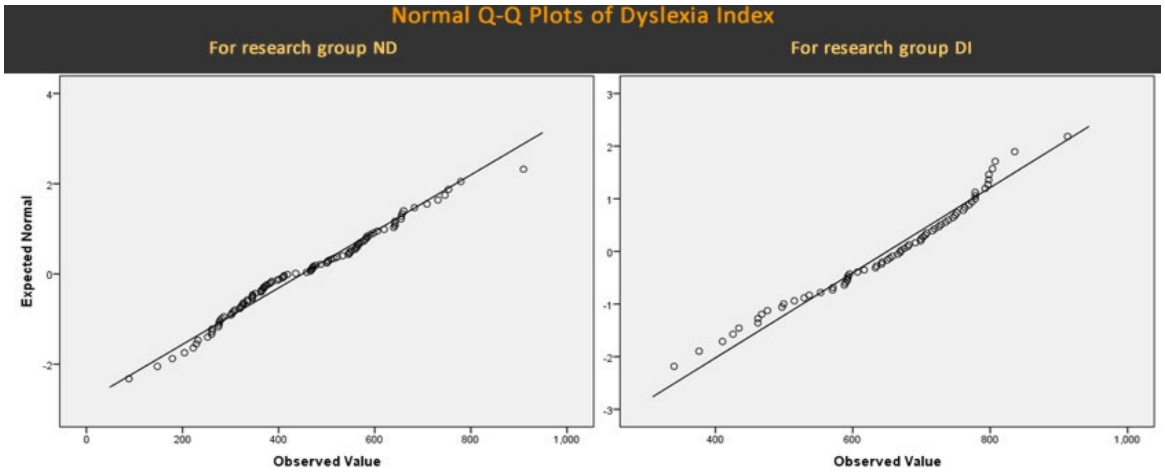


Figure 16: Normal Q-Q plots for Dyslexia Index.

III SETTING BOUNDARY VALUES FOR DX

1. DX BOUNDARY VALUE FOR THE TEST AND CONTROL SUBGROUPS

Some studies suggest that the proportion of known dyslexic students studying at university is likely to be much lower than the true number of students with dyslexia or dyslexia-like study characteristics (e.g.: Richardson & Wydell, 2003; MacCullagh et al., 2016; Henderson, 2017). This current study was grounded on this (amongst other) research outcomes, and the core of the research design was to devise a robust mechanism to detect such quasi-dyslexic students so that their academic confidence could be compared to the other groups and subgroups which emerged from the datapool. Hence, to establish this Test subgroup of quasi-dyslexic students, it was necessary to define a boundary Dx value, or at least a boundary region, in the group of non-dyslexic students above which datasets would be filtered into the Test subgroup, with the same protocol being applied to datasets in the dyslexic group to establish the Control subgroup. At the design stage, setting a value of Dx = 600 as the filter was considered intuitively reasonable because this corresponded to an average 60% agreement with the 20 dyslexia-ness dimensions of the original Dx Profiler. The scale was set so that higher percentage dimension-statement agreement was the marker for higher levels of dyslexia-ness.

For datasets derived from the 20-item scale, applying the Dx > 600 boundary value to the non-dyslexic group initially generated a Test subgroup of n=20 quasi-dyslexic students - that is, individuals with no previously reported dyslexia but who appeared to be presenting similar levels of dyslexia-ness to students in the dyslexic group. Applying the same Dx filter value to datasets in the dyslexic group established the Control subgroup of students presenting similarly high levels of dyslexia-ness, which numbered 47 out of the 68 students with declared dyslexia.

However, in order for the academic confidence of the Test and Control subgroups to be compared later (through ABC Scale outcomes), it was important to establish that the defining Dx parameters for each of these two subgroups were similar (statistically *not* significantly different). At the Dx = 600 filter boundary level, the mean Dx20 for the Test and Control subgroups were Dx = 676, 716, respectively. These were shown to be significantly different ($t(43) = 2.374$; $p = 0.011$) and thus, a more appropriate boundary was required. By selecting different values close to Dx = 600 (with the added consequence of some datasets being included or omitted into the respective subgroups), it

became clear that to set a fixed boundary Dx value was not a realistic objective. This was due to the subgroup means being unduly affected by extreme Dx values, predominantly from amongst the datasets in the dyslexic group where the highest Dx20 value recorded was Dx=933, compared to Dx=831 in the non-dyslexic group (see Table 11). Although these values were not identified as notable outliers from inspection of the distributions' box-plots, it was necessary to consider them as such so that the mean Dx values of datasets in the Test and Control groups would not be significantly different.

Consequently, some datasets from the upper end of the dyslexic group's range were omitted from the Control subgroup, tis caused the lower boundary Dx values for the Test and Control subgroups to emerge at slightly different points on the dyslexia-ness continuum - although both remained close to the intuitively determined value of Dx=600. For the 20-item scale this process subsequently determined the Dx20 mean values for the Test and the Control groups at Dx=683 and Dx=705 respectively, outcomes which emerged as not significantly different ($t(31) = 1.352$; $p = 0.093$). This process was repeated for the 16-item scale. The lower value of the Dx range indicates the critical boundary Dx values finally adopted for each variant of the Profiler (Table 12).

Scale	Subgroup	sample size, n	mean Dx	Dx range
Dx20	Test	18	683	623 < Dx < 832
	Control	40	705	614 < Dx < 812
		t-test outcome:	t(160) = 1.32; p < 0.09	
Dx16	Test	19	696	611 < Dx < 889
	Control	43	724	604 < Dx < 830
		t-test outcome:	t(160) = 1.48; p < 0.07	

Table 12: Dx parameters for the Test and Control subgroups.

2. Dx boundary value for the Base subgroup

A lower boundary value was required to filter the additional comparator subgroup of students from the non-dyslexic group who presented low levels of dyslexia-ness - the Base subgroup. It was considered intuitively reasonable to set this value at Dx = 400, thus representing a mean average agreement of 40% with the dyslexia-ness dimensions in the Profiler. Using the Dx20 scale, this generated a Base subgroup of n=44, representing 45% of the non-dyslexic students, or 55% of the remaining non-dyslexic students after the Test subgroup had been filtered out. Using the Dx16 scale, the Base subgroup comprised n=50 students (51%, 63% respectively).

By contrast, only five (Dx20) or three (Dx16) students with declared dyslexia presented values of Dx < 400. Given that these datasets were not identified as outliers to be excluded from further analysis, these remained anomalous results for other reasons, although no additional information about these students was available to enable any conclusions to be drawn.

It is of note that sizeable minorities of non-dyslexic students presented Dx levels between the upper boundary value of the Base subgroup (Dx20, Dx16 = 400) and the lower boundary value of the Test subgroup (Dx20 = 623, Dx16 = 611). Using the 20-item scale, 36 students fell into this category whereas the 16-item scale identified slightly fewer (n=29). In either case these data suggest approximately one-third of the students in this datapool presented levels of dyslexia-ness that placed them in the central area of the Dyslexia-ness Continuum. This is discussed below (Section 5).

SENSITIVITY AND SPECIFICITY OF THE DX PROFILER

As the Profiler was not a test for dyslexia, establishing values for the sensitivity and specificity of the Profiler was considered erroneous. However, by applying the critical boundary values of Dx=614 (for the Dx20 scale) and Dx=604 (for the Dx16 scale) (see Table 12) above which participants were classified as dyslexic for the purposes of this study (i.e. sifted into the Control subgroup), the Dx Profiler identified 45/68 (66%) of the dyslexic group to be dyslexic using the Dx20 scale, and 50/68 (74%), using the Dx16 scale.

IV ACADEMIC BEHAVIOURAL CONFIDENCE

I INTERNAL RELIABILITY OF THE ABC SCALES

There are currently two versions of the ABC Scale widely available to researchers: a 24-item scale which emerged out of the earlier, Academic Confidence Scale (Sander & Sanders, 2003) together with a later, 17-item scale developed through a meta-analysis of several studies, item redundancy analysis conducted through scale reliability interpretations, and dimension reduction processes (Sander & Sanders, 2009).

In a relatively early study using the 24-item scale, Sander and colleagues reported it to possess an internal reliability of $\alpha = 0.88$ (2007), based on data acquired from a sample of 284 participants drawn from two UK universities. All other studies using the ABC Scale found to date, appear to have either relied on this α-value, or only report the internal reliability of the ABC Scale's sub-scales, as derived by prior dimension reduction (op cit). With one exception, no other studies were found that indicated item redundancy analysis nor dimension reduction of the ABC 24-item scale as a mechanism for a more nuanced analysis of local data. The exception was a short conference paper detailing a statistical evaluation of the factor structure of the preceding, Academic Confidence Scale, that used data collected from a local university (Corkery, et.al., 2011), and although no overall measure for scale reliability was indicated, coefficients for the three subscales were presented, with values ranging from $0.711 < \alpha < 0.880$.

In this current study, data were collected using the original, 24-item scale because this permitted 17-item scale outputs to be generated simultaneously. Reliability analysis was conducted on both versions, and this process also permitted scale item redundancy to be considered for the 24-item scale based on local data. Items were identified as redundant using the same protocols as for the Dx Profiler (see 4.3/III.1), that is, by inspection of the matrices of item correlation coefficients (not shown) and adopting the $r > 0.7$ criterion.

Results suggested two alternatives to the existing ABC Scales, one comprising 17 items (co-incidentally), the other a 21-item scale. The local 17-item scale emerged as similar but not identical to the Sander and Sanders version (for the differences, see sub-section 4.5, below). Scale and sub-scale reliability coefficients all exceeded α > 0.7, widely considered as an appropriate critical value for indicating a reasonable balance between strong levels of internal reliability, and possible scale item redundancy (Table 13).

ABC Scale	α, Scale	α, Factor 1	α, Factor 2	α, Factor 3
ABC24	0.914	0.877	0.839	0.820
ABC17	0.874	0.889	0.770	0.727
ABC21-L (local)	0.899	0.855	0.807	0.794
ABC17-L (local)	0.877	0.844	0.786	0.707

Table 13: Reliability coefficients for the ABC Scales and sub-scales

Hence a variety of alternatives were available, both at scale and sub-scale level, for relating the data collected in this study to the focus of the enquiry, the research questions, and hypotheses being explored. It was considered that the results that emerged from all versions of the ABC Scale with the three, comparison subgroups defined according to both Dx Profiler Scales, was a strength of the study because interpretation of the differences in outcomes that emerged contributed positively to the discussion element of this thesis (Section 5).

II Differences in mean ABC values

When the subgroups were determined by either the Dx20 of the Dx16 Profiler scales, mean ABC values (Table 14) and effect sizes (Tables 15, 16) were found to be similar between the non-dyslexic and dyslexic groups overall, and also between the Test and Control subgroups, and between the Base and Control subgroups. The locally-derived, ABC17-L Scale consistently produced the highest mean ABC values across the range of groups and subgroups (ranging between ABC17-L = 60.53 for the Control subgroup and ABC17-L = 73.52 for the Base subgroup, as derived from the Dx16 Profiler), whereas the complete ABC24 Scale generated the most pessimistic outputs.

However, differences in mean ABC values from the four variants of the scale within each of the groups and subgroups were small, ranging between 0.84 mean value percentage points for the Dx20 Base subgroup (ABC24 = 72.44 to ABC17-L = 73.28) to 2.91 mean value percentage points for the Dx20 Control subgroup (ABC17 = 57.92 to ABC17-L = 60.83).

group / subgroup	Dx Scale	n	mean ABC24	mean ABC17	mean ABC21-L	mean ABC17-L
ND (all non-dyslexic students)	-	98	67.21	67.51	68.08	68.30
DI (all dyslexic students)	-	68	58.45	58.40	59.48	60.48
ND / Base	Dx20	44	72.44	72.61	73.44	73.28
"	Dx16	50	72.54	72.79	73.45	73.52
ND / Test	Dx20	18	61.72	62.08	62.60	63.21
"	Dx16	19	63.69	63.68	64.46	65.95
DI / Control	Dx20	40	58.05	57.92	59.20	60.83
"	Dx16	43	57.94	57.83	59.17	60.53

Table 14: Summary of ABC mean values by research group and subgroup according to ABC, and Dx scales

ABC Scale	Dx20 Scale: group / subgroup	ABC24 Group DI	ABC 24 Control	ABC17 Group DI	ABC17 Control	ABC21-L Group DI	ABC21-L Control	ABC17-L Group DI	ABC17-L Control
ABC24	Group ND	0.604							
	Base		1.027						
	Test		0.242						
ABC17	Group ND			0.621					
	Base				1.029				
	Test				0.268				
ABC21-L	Group ND					0.598			
	Base						1.034		
	Test						0.226		
ABC17-L	Group ND							0.532	
	Base								0.876
	Test								0.184

Table 15: ABC Scales' effect sizes (Hedges' g) when the subgroups were defined according to the Dx20 Profiler.

ABC Scale	Dx16 Scale: group / subgroup	ABC24 Group DI	ABC 24 Control	ABC17 Group DI	ABC17 Control	ABC21-L Group DI	ABC21-L Control	ABC17-L Group DI	ABC17-L Control

ABC24	Group ND	0.604							
	Base		1.086						
	Test		0.406						
ABC17	Group ND			0.621					
	Base				1.079				
	Test				0.400				
ABC21-L	Group ND					0.598			
	Base						1.086		
	Test						0.378		
ABC17-L	Group ND							0.532	
	Base								0.953
	Test								0.392

Table 16: ABC Scales' effect sizes (Hedges' *g*) when the subgroups were defined according to the Dx16 Profiler.

4.4 RELATING RESULTS TO HYPOTHESES

I DIFFERENCES IN ABC BETWEEN THE NON-DYSLEXIC AND THE DYSLEXIC GROUPS:

The greatest, absolute difference in mean ABC values between the non-dyslexic and the dyslexic groups was 9.11 percentage points generated from the ABC17 Scale (from Table 14), which suggests that when ABC is gauged according to the criteria on that scale, non-dyslexic students are expressing, on average, 16% higher levels of academic confidence relative to their non-dyslexic peers. The corresponding, least absolute difference of 7.82 percentage points (ABC17-L Scale, from Table 15) still suggests a 13% relative difference.

In comparison with their non-dyslexic peers, (RG:ND), students with a declared dyslexic learning difference (RG:DI) presented a significantly lower mean ABC (67.21-68.30, 58.40-60.48 respectively), indicated by a moderate effect size ($0.532 < g < 0.621$; [~, 0.938-0.945]), supported by a significant difference in sample means (ABC17: $t(134) = 3.86$, $p < 0.001$; ABC17-L: $t(137)=3.33$, $p < 0.001$).

Thus, Null Hypothesis (1), that there is no difference in mean ABC between the two groups, is rejected in favour of Alternative Hypothesis (1), that non-dyslexic students present a higher mean ABC than their non-dyslexic peers.

II DIFFERENCES IN ABC BETWEEN THE NON-DYSLEXIC (BASE) AND DYSLEXIC (CONTROL) SUBGROUPS:

When students presenting particularly high levels of dyslexia-ness in the Control subgroup were compared to non-dyslexic students with low levels of dyslexia-ness in the Base subgroup, the differences are more marked. These criteria established the greatest absolute difference in mean ABC at 14.96 percentage points (from Table 15: Dx16 Scale, ABC17: Base: 72.79, Control: 57.83). The least difference between students in these subgroups of 12.45 percentage points (ABC17-L, Dx16) still represented a substantial difference. In the most extreme case, those values represented a 26% relative difference between the academic confidence of strongly dyslexic students and their strongly non-dyslexic peers when levels of dyslexia-ness were taken as the gauge. When sample size and distribution variances were taken into account, the greatest effect size of $g = 1.0864$, [~,1.526] emerged when the 24-item ABC Scale was used to gauge datasets sifted into the Control and Base subgroups using the Dx16 Scale. This effect size was considered as large to very large.

In comparison with their strongly non-dyslexic peers in the Base subgroup, students in the Control subgroup of identified, dyslexic students present a significantly lower mean ABC (72.44-73.44, 57.83-60.83, respectively), indicated by a large effect size ($0.876 < g < 1.086$ [~, 1.329-1.385]), supported by corresponding NHST outcomes (ABC17-L, Dx20: $t(77)=3.98$, $p < 0.001$; ABC24, Dx16: $t(83)=5.16$, $p < 0.001$).

III DIFFERENCES IN ABC BETWEEN THE QUASI-DYSLEXIC (TEST) AND DYSLEXIC (CONTROL) SUBGROUPS:

With attention focused on differences between students in the quasi-dyslexic, Test, subgroup and the dyslexic students in the Control subgroup, the outcomes were less marked but still of interest. Overall, when any of the ABC Scales were applied to datasets in these subgroups, whether sifted according to the Dx20 Profiler Scale or the Dx16 alternative, mean ABC values were higher for the quasi-dyslexic students when compared with their identified-dyslexic peers.

Whichever ABC Scale was used, differences between ABC means were greater than 5 percentage points when the Test and Control subgroups were generated from the Dx16 Profiler, with the greatest, absolute difference in mean ABC of 5.85 percentage points when the ABC17 Scale was applied (from Table 14). Taking into account distribution variances and sample sizes, effect sizes were in the range $0.378 < g < 0.406$, with confidence interval upper boundaries falling in the range [~,0.924] to [~,0.954]. These represent moderate-to-low effect sizes although the true effect sizes may be substantially larger, as indicated by the upper boundaries of the confidence intervals. Given the small sample size of the Test subgroup, (n=19) in comparison to the Control subgroup (n=43), this degree of imprecision is not unexpected. Effects were smaller when datasets were generated and sifted according to the Dx20 Profiler, with absolute differences ranging between 2.38 and 4.16 percentage points, corresponding to an effect size range of $0.184 < g < 0.268$, ([~,0.744] to [~,0.828]), with uncertainty likely to be related to sample sizes (Test: n=18, Control: n=40). However, in all cases, the mean ABC for the quasi-dyslexic subgroup exceeded levels for the dyslexic subgroup.

Thus, in comparison with students in the Control subgroup of identified, dyslexic students, quasi-dyslexic students in the Test subgroup presented a higher mean ABC (57.83-60.83, 61.72-65.95 respectively) indicated by a low-to-moderate effect size ($0.184 < g < 0.406$; [~, -0.744-0.954]). None of the NHST outcomes indicated differences to be significant although the outcome generated from the ABC17 Scale and the Dx16 Profiler was marginal ($t(38)=1.504$, $p=0.0703$). Hence evidence to reject the Null Hypothesis (2) was also marginal when based on students in this datapool. However, the differences that did emerge presented a clear pattern, with quasi-dyslexic students consistently presenting higher levels of academic confidence on average, than their dyslexia-identified peers.

Implications of these outcomes are discussed below (Section 5).

4.5 Further analysis: Dimension reduction

I Applying dimension reduction to the ABC Scales and the Dx Profilers

The ABC Scales and Dx Profilers are multi-dimensional, continuous variable, linear scales. Of the many dimension reduction techniques available to explore possible sub-scale structures, Principal Component Analysis (PCA) was chosen as the most appropriate firstly, because all precedents for dimension reduction applied to the ABC Scale had used this process, and hence guidance was available; secondly, a factor structure that emerged from PCA on the data in this current

study could then be considered alongside existing factor structures for the ABC Scale determined from similar processes.

To maintain consistency of dimension reduction, and also to minimize computational complexity, PCA was also the preferred choice for the Dx Profiler. However, because this metric was developed uniquely for this study, only the locally collected data (n=166 participants) were available. Consequently, the factor analysis of the Dx Profiler was considered unlikely to be sufficiently reliable to contribute to a deeper interpretation of the data in this study. However, the process was completed to assess whether any early indications of a possible sub-scale structure emerged. Reserving data until they can be supplemented from subsequent studies was considered the most prudent course of action.

Furthermore, it was anticipated that once the dimension reduction processes were completed, determining the number of factors to retain was likely to be far from straightforward, not least in the light of controversy in research communities about the best criteria to adopt. Hence, parallel analyses using randomized raw score data simulations were conducted to aid this process (Eigenvalue Monte Carlo Simulations).

ASSUMPTIONS AND PRELIMINARY WORK

Although complete-scale outcomes have enabled the research hypotheses to be addressed and conclusions drawn, precedents set for the ABC Scale indicated that applying dimension reduction to explore any factor structure which may emerge could reveal more nuanced outcomes, subsequently permitting a deeper interpretation of the data collected. In this current study, four possible ABC Scales emerged as contenders for the most appropriate for analysing data, together with two versions of the Dx Profiler. Assumptions and preliminary work was carried out for all of these, but as exemplars, details are reported for the ABC24 Scale and for the Dx16 Profiler, although identical processes were conducted for all scales which produced similar results.

For a PCA to be valid, it is considered that a scale-item variable that presents a correlation of $r \geq 0.3$ with at least one other scale-item variable is worthy of inclusion in the analysis (Hinton et al., 2004). An analysis of the inter-variable correlation matrix for both metrics showed that for the ABC24 Scale, 138 out of the 300 possible correlations returned a coefficient of $r \geq 0.3$ with all variables returning at least one correlation of $r \geq 0.3$. For the Dx16 Profiler, of the 120 possible correlation outcomes, 80 returned a Pearson correlation coefficient of $r \geq 0.3$, also with all variables returning at least one correlation of $r \geq 0.3$ with any other variable.

Furthermore, sufficient sampling adequacy is fundamental to PCA, but this adequacy is a function of the number of observations rather than the sample sizes(s) per se. Statistical conventions indicate that at least 150 observations would be a sufficient condition (Guadagnoli & Velicer, 1988) although a later study suggests that aspects of the variables and the study design have an impact on determining an appropriate level of sampling adequacy, recommending that this is improved with a higher number of observations (McCallum et al., 1999). In the current study 4,032 observations for the ABC24 Scale, and 2,656 for the Dx16 Profiler were recorded. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy produced values of 0.866 for the ABC24 Scale and KMO = 0.889 for the Dx16 Profiler. Measures of sampling adequacy for individual

variables were examined to ensure that these also confirm the appropriateness for factor analysis. For ABC24, the individual variables measures returned values of $0.753 \leq KMO \leq 0.929$, and for Dx16, $0.563 \leq KMO \leq 0.924$. According to Kaiser's (1974) own classification, KMO values can range from 0 to 1, with a value of $KMO \geq 0.5$ considered desirable (Hinton el.al, 2004). Finally, the null hypothesis that there are no correlations between any of the variables was tested using Barlett's Test of Sphericity where a rejection is sought as determined by a *p*-value of $p < 0.05$. When applied to both the ABC Scale and to Dyslexia Index, the test returned values of $p < 0.001$.

Thus, for both metrics, the null hypothesis that there are no correlations between the metrics' variables is rejected and that sufficient levels of sample adequacy were also achieved. Therefore, justification for running the PCA on both metrics is met.

II EIGENVALUE MONTE CARLO SIMULATIONS

No studies found to date which have used the ABC Scale as their principal metric have indicated that sub-scale structures that emerged through PCA, based on the data within them, were tested against structures that might have occurred by chance. Indeed, of the numerous studies that were examined, with one exception, all have relied on the factor structures developed by the Scale originators, where 6 factors were determined for the 24-item scale, reduced to 4 factors in the ABC17 Scale. Only Corkery et.al. (2011) reported a 3-factor solution for their data. Early analysis of the data in the current study for the ABC24 Scale indicated that possible 6-factor, 5-factor or 4-factor solutions may provide an appropriate PCA outcome to permit a more in-depth examination of the data (sub-section 4.1/II.4). This was based on both the eigenvalues > 1 principal, and the visual inspection of scree plots.

With all solutions showing equal merit, a parallel (simulation) analysis (Horn, 1965) was conducted to determine how any (or all) of these solutions compared with a sub-scale structure likely to have occurred by chance. Also known as the Eigenvalue Monte Carlo Simulation (O'Connor, 2000), this statistical process determines the number of factors which are likely to have occurred through use of random data (or, more usefully, a randomized version of the experimentally acquired data in a study). By running multiple, simulated reductions, not only are mean value eigenvalues produced in the table of total variance explained, but also critical values are generated where the boundary is conventionally set at the 95th percentile, in much the same fashion as for NHST. Comparison is then made between the eigenvalues generated in the PCA of the raw data with the 95th percentile boundary values for eigenvalues generated from the parallel analysis. Data-generated values that are greater than their parallel analysis, 95th percentile critical value, are statistically significant, and therefore are unlikely to have occurred by chance. Hence only those factors are retained in the final solution.

I EIGENVALUE MONTE CARLO SIMULATION FOR ABC24 AND ABC17 SCALES:

For both the ABC24 and ABC17 Scales, parallel analysis simulation of 1000 random permutations of the raw data collected in this study identified three components to retain based on their eigenvalues exceeding the equivalent random data 95th percentile critical value (Tables 17, 18). This was also illustrated by the points of intersections of the comparative scree plots for both scales (Figure 17; scree plot for ABC17 Scale not shown), which occurred at eigenvalues between those for the third and fourth components. Hence this suggested that a three-factor solution was the most appropriate extraction to use for the ABC data in this current study, thus displacing the earlier solutions derived from either the eigenvalues > 1 or the visual inspection of the scree plot criteria (or both).

ABC 24 Component	Eigenvalue (raw data)	Eigenvalue (mean value, simulations)	95th %ile Eigenvalue (simulations)
1	8.3899	1.7682	1.8949
2	2.3844	1.6377	1.7309
3	1.9199	1.5400	1.6158
4	1.2106	1.4553	1.5209
5	1.1295	1.3797	1.4367

6	0.9625	1.3132	1.3678
7	0.8943	1.2503	1.3049
8	0.8353	1.1909	1.2389
9-24	< 0.761	< 1.136	< 1.181

Table 17: Parallel Analysis: Principal components and raw data permutations for the ABC24 Scale

ABC 24 Component	Eigenvalue (raw data)	Eigenvalue (mean value, simulations)	95th %ile Eigenvalue (simulations)
1	6.009	1.6011	1.7274
2	1.9909	1.4724	1.5661
3	1.7972	1.3769	1.4481
4	1.0532	1.2937	1.3589
5	0.9552	1.2212	1.2783
6	0.8058	1.1517	1.2509
7	0.6917	1.0881	1.1418
8	0.6329	1.0286	1.0786
9-24	< 0.5592	< 0.9703	< 1.10187

Table 18: Parallel Analysis: Principal components and raw data permutations for the ABC17 Scale

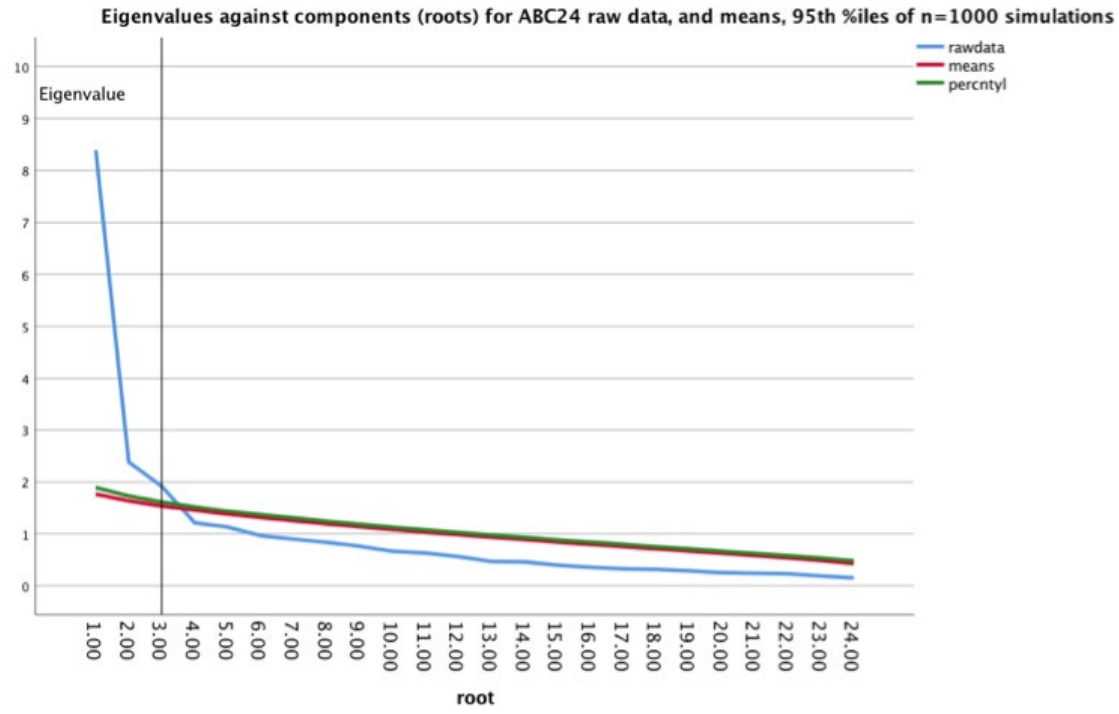


Figure 17: Scree plot of raw data and Eigenvalue Monte Carlo Simulations for the ABC24 Scale

II Eigenvalue Monte Carlo Simulation for the Dx Profiler Dx20 and Dx16 Scales:

For the Dx20 version of the Profiler a similar, parallel analysis simulation of again, 1000 random permutations of the raw data clearly identified two significant eigenvalues with a third falling on the 95th percentile critical boundary (within three significant figures) (Table 19, Figure 18). The same simulation applied to the scale variables of the 16-item Dx Profiler conversely indicated that no sub-structure scale could be reasonably determined (Table 20) and that the Dx16 Profiler was best considered as a single-factor gauge of dyslexia-ness for the datasets in this current study.

Dx20 Component	Eigenvalue (raw data)	Eigenvalue (mean value, simulations)	95th %ile Eigenvalue (simulations)
1	6.3364	1.6774	1.8068
2	1.9701	1.5470	1.6289
3	1.5215	1.4505	1.5238
4	1.2009	1.3650	1.4304
5	1.0600	1.2909	1.3485
6	0.9878	1.2237	1.2779
7	0.8007	1.1614	1.2102
8-20	< 0.7598	< 1.1024	< 1.1481

Table 19: Parallel Analysis: Principal components and raw data permutations for the Dx20 Profiler.

Dx16 Component	Eigenvalue (raw data)	Eigenvalue (mean value, simulations)	95th %ile Eigenvalue (simulations)
1	6.2341	1.5782	1.7075
2	1.2992	1.4408	1.5304
3	1.1998	1.3503	1.4223
4	0.9675	1.2667	1.3283
5	0.8751	1.1937	1.2469
6	0.8202	1.1259	1.1793
7	0.7607	1.0632	1.1125
8-16	< 0.6525	< 1.0017	< 1.0485

Table 20: Parallel Analysis: Principal components and raw data permutations for the Dx16 Profiler.

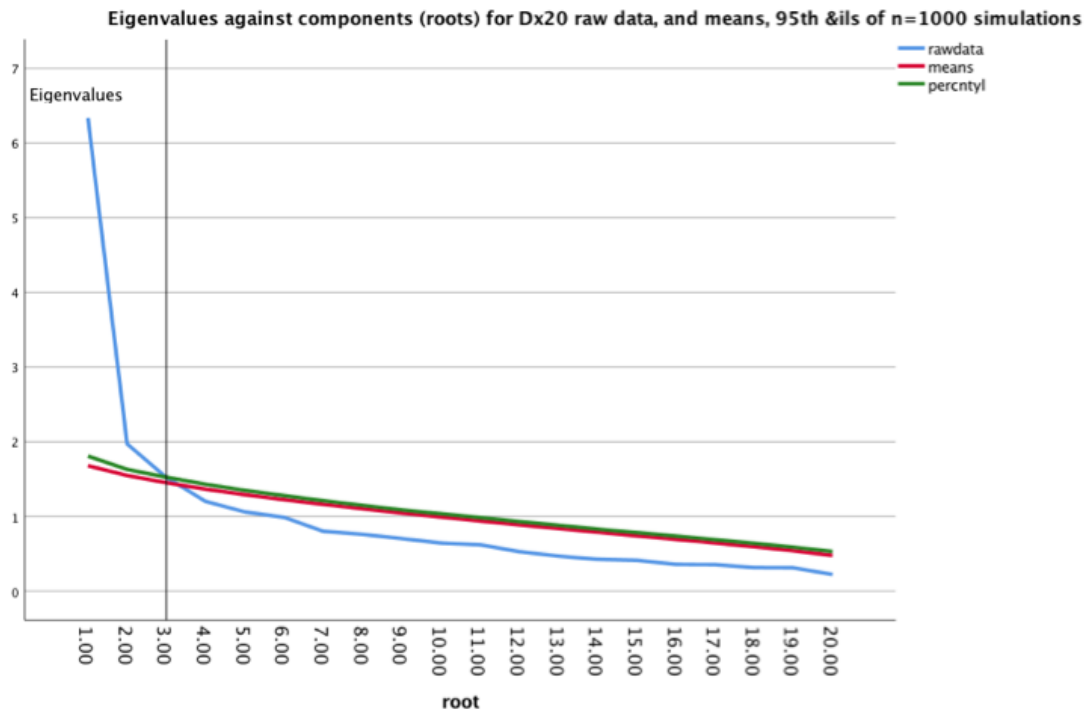


Figure 18: Scree plot of raw data and Eigenvalue Monte Carlo Simulations for the Dx20 Profiler Scale.

III PCA ON ACADEMIC BEHAVIOURAL CONFIDENCE

As a consequence of the Eigenvalue Monte Carlo Simulations suggesting a three-factor structure to be the most likely to provide meaningful outcomes, dimension reduction through PCA was applied to the four ABC Scales that emerged as useful in this current study. Varimax rotation was applied, being an orthogonal rotation method which assumes that the factors in the analysis are uncorrelated, where rotation of the factors is a mathematical process, usually employed to determine the simplest factor structure that is most likely (Kieffer, 1998). Other rotations were considered, but in the interests of expediency, only the two most popular were explored further: that is, to determine whether these data were best analysed using an orthogonal (eg: varimax) rather than an oblique (eg: direct oblimin) rotation. For these data, the factor correlation matrix (not shown) derived through an oblimin rotation showed only one correlation to be (marginally) > 0.32, considered as the critical factor for determining whether an oblique rather than an orthogonal rotation is the most appropriate (Tabachnik & Fiddel, 2007); this suggests that although either rotation would generate meaningful outcomes, an orthogonal process is said to produce less sampling error (op cit) and hence was chosen.

With an extraction that fixed the number of components (factors) at three, the rotated component matrix for the reduction of the ABC24 Scale shows reasonably distinct factors (Table 21), although some dimensions loaded onto more than one factor (factor loadings < 0.3 were supressed in the output). The reduced ABC17 Scale is also shown, both to indicate which scale items were removed as redundant through the original re-analysis of the scale (Sander & Sanders, 2009), and how factor loadings were distributed across the three sub-scale solution derived in this current study. The two alternative, locally derived scales, ABC21-L and ABC17-L were also complex, again with some dimensions loading onto more than one factor (Table 22). In these cases, dimensions were attributed to the highest-loading factor (Table 24, further below). Where factor loadings for a dimension were only marginally different, a reasonable judgement was made about which factor to select (Table 22).

ABC Scale Item	ABC24 Factor 1	ABC24 Factor 2	ABC24 Factor 3	ABC17 Factor 1	ABC17 Factor 2	ABC24 Factor 3
15: produce coursework at the required standard	0.828			0.835		
07: attain good grades	0.792			0.813		
16: write in an appropriate styles	0.771			0.771		
20: pass assessment at the first attempt	0.678			0.680		
23: produce best work in coursework assignments	0.645		0.349	0.698		
01: study effectively in independent study	0.560		0.406	0.617		0.309
04: manage workload to meet deadlines	0.524		0.506	0.591		0.433
22: remain adequately motivated throughout university	0.500		0.440	0.559		0.389
10: ask lecturers questions during a lecture		0.798			0.793	
03: respond to lecturers questions in a full lecture theatre		0.791			0.845	
12: follow themes and debates in lectures		0.716		x	x	x
05: present to a small group of peers		0.646			0.700	
08: debate academically with peers		0.608			0.559	
11: understand material discussed with lecturers		0.592		x	x	x
09: ask lecturers questions in one-to-one settings		0.516		x	x	x
17: ask for help if you need it		0.480		x	x	x
02: produce best work in exams	0.327	0.470		0.305	0.564	
24: attend tutorials			0.721			0.765
06: attend most taught sessions			0.721			0.773
18: be on time for lectures			0.677			0.707
14: read recommended background material	0.345		0.579	x	x	x
21: plan appropriate revision schedules	0.529		0.535	0.579		0.451
19: make the most of university study opportunities	0.342	0.303	0.529	x	x	x
13: prepare thoroughly for tutorials	0.481		0.528	x	x	x

Table 21: Rotated component matrix for ABC24 and ABC17 Scales (Sander & Sanders) showing factor loadings, and which items were removed as redundant from the ABC24 Scale (x).

ABC Scale Item	ABC21-L Factor 1	ABC21-L Factor 2	ABC21-L Factor 3	ABC17-L Factor 1	ABC17-L Factor 2	ABC17-L Factor 3
15: produce coursework at the required standard	x	x	x	x	x	x
07: attain good grades	0.812			0.789		
16: write in an appropriate styles	0.733			0.718		
20: pass assessment at the first attempt	0.709			x	x	x
23: produce best work in coursework assignments	0.682		0.311	0.676		
01: study effectively in independent study	0.630		0.311	0.709		
04: manage workload to meet deadlines	0.564		0.436	x	x	x
22: remain adequately motivated throughout university	0.581		0.340	x	x	x
10: ask lecturers questions during a lecture	x	x	x	x	x	x
03: respond to lecturers questions in a full lecture theatre		0.763		x	x	x
12: follow themes and debates in lectures		0.742			0.718	
05: present to a small group of peers		0.638			0.653	
08: debate academically with peers		0.638			0.726	
11: understand material discussed with lecturers		0.604		x	x	x
09: ask lecturers questions in one-to-one settings		0.539			0.611	
17: ask for help if you need it	0.370	0.421		0.386	0.467	
02: produce best work in exams	0.337	0.484		0.432	0.357	
24: attend tutorials			0.712			0.742
06: attend most taught sessions			0.770			0.783
18: be on time for lectures			0.700			0.733
14: read recommended background material	0.374		0.545	x	x	x
21: plan appropriate revision schedules	x	x	x	0.680		
19: make the most of university study opportunities	0.447		0.498	0.491	0.318	0.408
13: prepare thoroughly for tutorials	0.493		0.498	0.617		

Table 22: Rotated component matrix for locally derived ABC21-L and ABC17-L Scales, showing factor loadings, and which items were removed as redundant from the ABC24 Scale (x).

PROPORTION OF VARIANCE EXPLAINED

I - ABC24 SCALE

The PCA process determines the percentage contributions of the total variance made by each of the variables if all of the components are retained. For the ABC24 Scale, the three factors which were retained from this analysis cumulatively accounted for 52.9% of the total variance, with the most significant influence from Factor 1, which explained almost 35.0% of the total variance (Table 23). Despite the extraction being directed by the three-factor solution indicated by the parallel analysis simulation (above), it is notable that eigenvalues for the fourth, and fifth components are significantly above the eigenvalue > 1 criterion, often applied for determining the number of factors to extract from a PCA. This may suggest that were a larger datapool available for the randomized raw data parallel analysis, a four-factor, or even five-factor solution may have been the outcome, leading to a forced, four or five factor extraction in the PCA for this data. Visual inspection of the scree plot (Figure 19) identifies a marked change in gradient at the fourth component, also suggesting that were this criterion applied, a four-factor solution would have been the likely conclusion.

ABC24 Component	Eigenvalue	% of variance	Cumulative % of variance
1	8.390	34.958	34.598
2	2.384	9.935	44.893
3	1.920	8.000	52.893
4	1.211	5.044	57.937
5	1.130	4.706	62.643
6	0.963	4.010	66.654
7	0.894	3.726	70.380
8	0.835	3.480	73.840
9	0.760	3.168	77.028
10	0.663	2.764	79.792
11-24	< 0.630	< 2.700	> 82.400

Table 23: Total variance explained for the PCA on the ABC24 Scale.

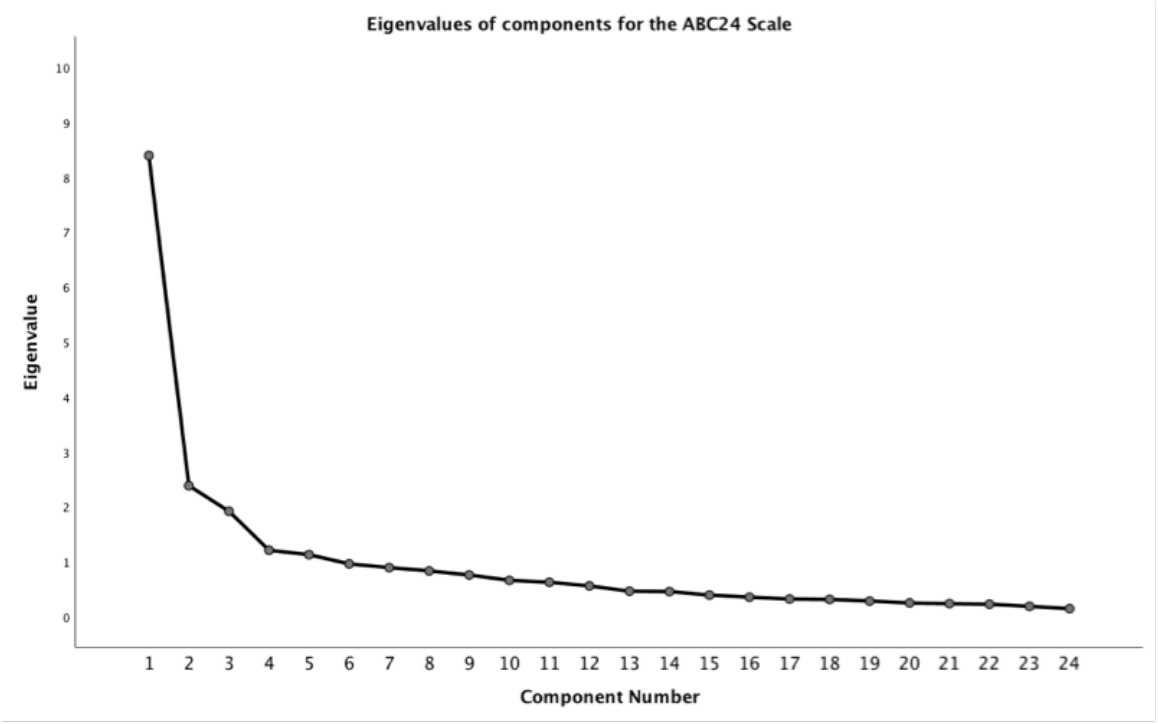


Figure 19: Scree plot of eigenvalues for components (factors) of PCA on the ABC24 Scale

II - ABC17, ABC21-L, and ABC17-L Scales

As expected, the distributions of proportions of variance for the three alternative versions of the ABC Scale used in this study are similar (Table 24). Scree plots of eigenvalues also presented similar characteristics to the ABC24 Scale scree plot, and hence are not shown.

ABC Component	ABC17 Eigenvalue	~ % variance	~ cumulative %	ABC21-L Eigenvalue	~ % variance	~ cumulative %	ABC17-L Eigenvalue	~ % variance	~ cumulative %
1	6.009	35.348	35.348	7.245	34.500	34.500	5.821	34.239	34.239
2	1.991	11.709	47.057	2.104	10.020	44.520	2.107	12.392	46.631
3	1.797	10.572	57.629	1.555	7.403	51.923	1.524	8.962	55.593
4	1.053	6.195	63.824	1.203	5.728	57.651	0.986	5.800	61.390
5	0.955	5.619	69.443	0.966	4.600	62.250	0.913	5.371	66.764
6	0.806	4.740	74.183	0.915	4.359	66.610	0.838	4.927	71.691
7 - ...	< 0.693	< 4.070	> 78.2	< 0.845	< 4.015	> 70.6	< 0.770	< 5.530	> 762

Table 24: Total variance explained for the PCA on the ABC17, ABC21-L, and ABC17-L Scales.

ABC Factors

Subsequent to the three-factor solutions of dimension reduction processes on the ABC Scales, factors were designated thematically according to their dimensional composition. Although the groupings of dimensions into factors varied slightly across the four versions

of the ABC Scales, common themes emerged which enabled consistent factor names to be assigned as: Factor 1, Study Efficacy; Factor 2, Engagement; Factor 3, Organization and Planning (Table 25). Thus, with dimensions assigned to factors, the dimension reduction process for the ABC Scales was completed, permitting comparisons in ABC Factor levels to be made across the research groups and subgroups (Section 4.6).

ABC Scale Item	ABC21-L Factor 1	ABC21-L Factor 2	ABC21-L Factor 3	ABC17-L Factor 1
01: study effectively in independent study	F1 study efficacy	F1 study efficacy	F1 study efficacy	F1 study efficacy
02: produce best work in exams	F2 engagement	F2 engagement	F2 engagement	F2 engagement
03: respond to lecturers questions in a full lecture theatre	F2 engagement	F2 engagement	F2 engagement	x
04: manage workload to meet deadlines	F1 study efficacy	F1 study efficacy	F1 study efficacy	x
05: present to a small group of peers	F2 engagement	F2 engagement	F2 engagement	F2 engagement
06: attend most taught sessions	F3 org & planning	F3 org & planning	F3 org & planning	F3 org & planning
07: attain good grades	F1 study efficacy	F1 study efficacy	F1 study efficacy	F1 study efficacy
08: debate academically with peers	F2 engagement	F2 engagement	F2 engagement	F2 engagement
09: ask lecturers questions in one-to-one settings	F2 engagement	x	F2 engagement	F2 engagement
10: ask lecturers questions during a lecture	F2 engagement	F2 engagement	x	F2 engagement
11: understand material discussed with lecturers	F2 engagement	x	F2 engagement	x
12: follow themes and debates in lectures	F2 engagement	x	F2 engagement	F2 engagement
13: prepare thoroughly for tutorials	F3 org & planning	x	F3 org & planning	F1 study efficacy
14: read recommended background material	F3 org & planning	x	F3 org & planning	x
15: produce coursework at the required standard	F1 study efficacy	F1 study efficacy	x	x
16: write in an appropriate styles	F1 study efficacy	F1 study efficacy	F1 study efficacy	F1 study efficacy
17: ask for help if you need it	F2 engagement	x	F2 engagement	F2 engagement
18: be on time for lectures	F3 org & planning	F3 org & planning	F3 org & planning	F3 org & planning
19: make the most of university study opportunities	F3 org & planning	x	F3 org & planning	F1 study efficacy
20: pass assessment at the first attempt	F1 study efficacy	F1 study efficacy	F1 study efficacy	x
21: plan appropriate revision schedules	F3 org & planning	F1 study efficacy	x	F1 study efficacy
22: remain adequately motivated throughout university	F1 study efficacy	F1 study efficacy	F1 study efficacy	x
23: produce best work in coursework assignments	F1 study efficacy	F1 study efficacy	F1 study efficacy	F1 study efficacy
24: attend tutorials	F3 org & planning	F3 org & planning	F3 org & planning	F3 org & planning

Table 25: Total variance explained for the PCA on the ABC17, ABC21-L, and ABC17-L Scales.

IV PCA ON DYSLEXIA INDEX

Parallel analysis simulations provided helpful insight into the possible sub-scale structure for the ABC Scale. However, when the approach was applied to the Dx Profiler Scales, Dx20 and Dx16, outcomes were mixed leading to an unconvincing level of confidence that any meaningful sub-scale structure could be determined, if based on the data collected in this study. Certainly for the Dx16 Scale, it seemed likely that this was best considered as a single-factor scale. The outcomes for the Dx20 Scale indicated that there may be two distinct sub-scales although the rotated component matrix showed that one of these comprised the four dimensions which had been previously identified as troublesome (Dx03, 05, 07, 13) and likely to be redundant according to reliability analysis (sub-section 4.3/III.1), thus establishing the Dx16 version of the Profiler. As the Monte Carlo simulation had indicated a possible borderline third eigenvalue, a three-factor solution for the Dx20 Scale was considered, but the factor loadings were also of dubious merit for identifying a meaningful structure (Table 26).

PROPORTION OF VARIANCE EXPLAINED

DX20 SCALE

The table of proportions of variance explained by the eigenvalues generated through the PCA on the Dx20 Scale indicated that in the absence of testing the dimension reduction outcome by applying a parallel analysis a four, or possibly five-factor solution may have been adopted as a sub-scale structure (Table 26) according to the eigenvalues > 1 criterion for retaining factors. Conversely, the scree plot (Figure 20) shows no substantial change in gradient beyond the second component, conventionally taken as an indicator for the number of factors to retain when this additional criterion is used. Hence, evidence to support further examination of a possible sub-scale structure for the Dx Profiler (in either version) was sparse or at best indeterminate, suggesting that using the Dx20 and the Dx16 Profiler Scales as single-factor scales would be a more prudent approach for further analysis of the data in this current study.

However, it is possible to speculate that were more data available to contribute to the dimension reduction process, a more robust three-factor solution may have been the outcome, at least for the Dx20 Scale. Hints of this were present in the distribution of factor loadings (Table 27), notable when dimensions are grouped factorially (Table 28), with suggestions for possible theme-based, factor names. Were it possible to adopt it, such a structure would demonstrate a neat alignment with components drawn from the BDA definition of dyslexia, identified above (sub-section 3.3(III.2(2.2)).

Dx20 Component	Eigenvalue	% of variance	Cumulative % of variance
1	6.336	31.682	31.682
2	1.970	9.851	41.532
3	1.522	7.607	49.109
4	1.201	6.005	55.144
5	1.060	5.300	60.444

6	0.988	4.939	65.383
7	0.801	4.003	69.387
8	0.760	3.799	73.185
9	0.703	3.517	76.702
10	0.643	3.217	72.919
11-20	< 0.621	< 3.100	> 83.0

Table 26: Total variance explained for components generated by PCA on the Dx20 Profiler Scale.

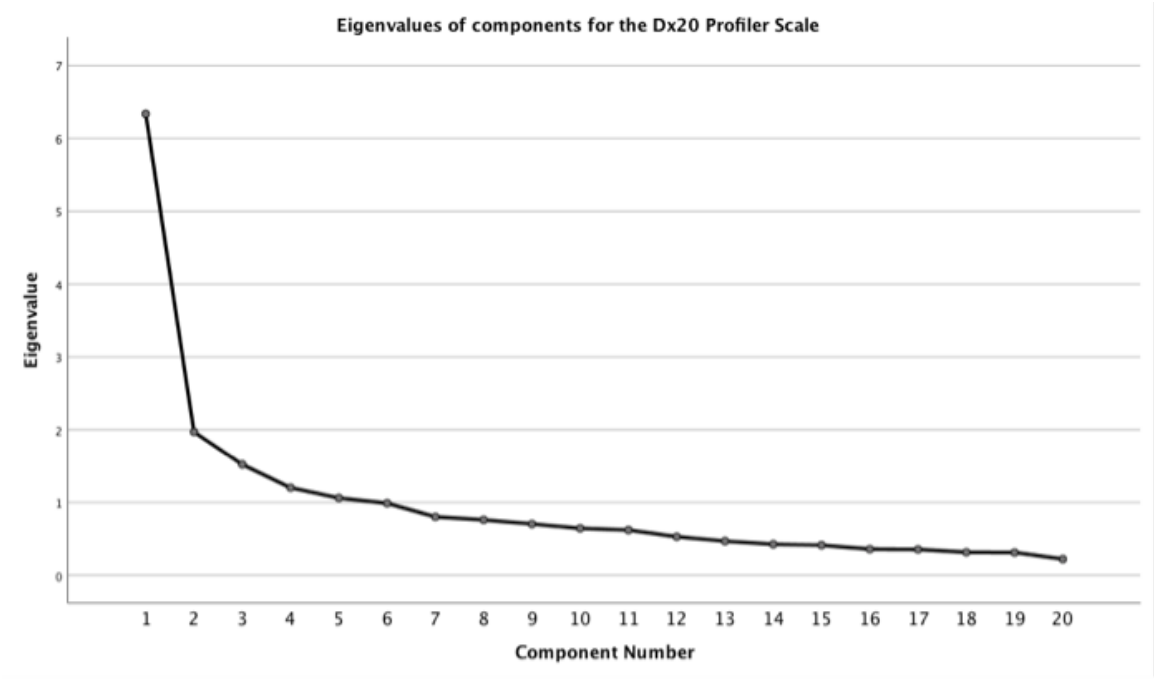


Figure 20: Scree plot of eigenvalues for components (factors) of PCA on the Dx20 Profiler Scale.

Dx20 Scale Item	Factor 1 (.../2)	Factor 2 (.../2)	Factor 1 (.../3)	Factor 2 (.../3)	Factor 3 (.../3)
06: In my writing, I frequently use the wrong word for my intended meaning	0.804		0.745	0.303	
09: I have difficulty putting my writing ideas into a sensible order	0.742		0.611	0.325	0.402
08: When I'm reading, I sometimes read the same line again, or miss out a line altogether	0.735		0.709		
01: When I was learning to read at school, I often felt I was slower than others in my class	0.696		0.678		
19: I get in a muddle when I'm searching for learning resources or information	0.689		0.620		0.371
10: In my writing at school, I often mixed up similar letters, like 'b' and 'd', or 'p' and 'q'	0.684		0.700		
18: My tutors often tell me that my essays or assignments are confusing to read	0.675		0.682		
20: I get really anxious when I'm asked to read 'out loud'	0.651		0.725		
02: My spelling is generally good*	0.619		0.702		
16: I find it really challenging to follow a list of instructions	0.586	0.382	0.522		0.488
11: When I'm planning my work, I use diagrams or mindmaps rather than bullet points or lists	0.540		0.399	0.454	
17: I get my lefts and rights easily mixed up	0.538		0.605		
04: I can explain things to people much more easily verbally, than in my writing	0.529		0.345	0.550	
12: I'm hopeless at remembering things like telephone numbers	0.496		0.511		
15: My friends say I often think in unusual or creative ways to solve problems	0.447		0.337	0.319	
05: I think I'm a highly organized learner*		0.762			0.768
07: I generally remember appointments and arrive on time*		0.740		-0.405	0.633
03: I find it very challenging to manage my time efficiently		0.652			0.790
13: I find following directions to get to places quite straightforward		-0.366		0.457	
14: I prefer looking at the big picture rather than focusing on details	0.279	-0.300		0.705	

Table 27: Factor leadings for 2-factor, and 3-factor solutions of PCA on the Dx20 Profiler (* dimension with reverse-coded data).

Dx20 Scale Item	Factor 1 Language & Literacy	Factor 2 Thinking & Processing	Factor 3 Time & Organization
06: In my writing, I frequently use the wrong word for my intended meaning	0.745	(0.303)	
20: I get really anxious when I'm asked to read 'out loud'	0.725		
08: When I'm reading, I sometimes read the same line again, or miss out a line altogether	0.709		
02: My spelling is generally good*	0.702		
10: In my writing at school, I often mixed up similar letters, like 'b' and 'd', or 'p' and 'q'	0.700		
18: My tutors often tell me that my essays or assignments are confusing to read	0.682		
01: When I was learning to read at school, I often felt I was slower than others in my class	0.678		
19: I get in a muddle when I'm searching for learning resources or information	0.678		
09: I have difficulty putting my writing ideas into a sensible order	0.611	(0.402)	(0.325)
17: I get my lefts and rights easily mixed up	0.605		
16: I find it really challenging to follow a list of instructions	0.522		(0.488)
12: I'm hopeless at remembering things like telephone numbers	0.511		
14: I prefer looking at the big picture rather than focusing on details		0.705	
04: I can explain things to people much more easily verbally, than in my writing	(0.345)	0.550	
13: I find following directions to get to places quite straightforward		0.457	
11: When I'm planning my work, I use diagrams or mindmaps rather than bullet points or lists	(0.399)	0.454	
15: My friends say I often think in unusual or creative ways to solve problems	(0.337)	0.319	
03: I find it very challenging to manage my time efficiently			0.790
05: I think I'm a highly organized learner*			0.768
07: I generally remember appointments and arrive on time*		(-0.405)	0.633

Table 28: Possible 3 factor sub-scale structure for the Dx20 Profiler (* dimension with reverse-coded data).

V COMPARING ABC FACTOR MEANS

The determination of a possible 3-factor sub-scale structure for the ABC Scales through dimension reduction enabled mean ABC levels to be calculated for each of the three factors. Comparisons were then made between the non-dyslexic and dyslexic groups, between the Test and Base, and between the Test and Control subgroups. The dataset composition of the sub-groups varied according to whether the Dx20 or Dx16 Profiler Scales were used to determine participants' levels of dyslexia-ness, reflected in variances in raw score differences and effect sizes (below). Outcomes derived from the four versions of the ABC Scales that were used, according to each of the Dx Profilers, revealed notable differences between within-factor means (Table 29).

The results of interest are the difference in factor mean ABC values between the Base and Control subgroups, and between the Test and Control subgroups (Table 29 and Figure 21). With participants' levels of dyslexia-ness gauged by the Dx20 Profiler, and for all ABC Scales' Factor 1: Study Efficacy, and Factor 2: Engagement, differences were substantial between the Base subgroup with low levels of dyslexia-ness (Dx < 400) and the Control subgroup of dyslexic students defined by levels of dyslexia-ness greater than the Dx=614 critical value for the Dx20 Scale. Only for Factor 3: Organization and Planning, were differences less pronounced with outcomes from the ABC17 Scale and the local ABC17-L Scale almost negligible. This pattern was repeated for mean ABC differences in Factors 1 and 2 between the quasi-dyslexic, Test, subgroup and the Control subgroup, with Factor 3 outcomes returning negative differences - that is, mean ABC values were stronger for the Control subgroup than for the Test subgroup. When the sub-groups were defined by outputs from the Dx16 Profiler, a similar pattern emerged (Figure 22).

Dx20	ABC factor means according to ABC Scale - Dx20 Profiler Outcomes											
group /subgroup	ABC Factor 1: Study Efficacy				ABC Factor 2: Engagement				ABC Factor 3: Organization & Planning			
ABC Scale->	ABC24	ABC17	ABC21-L	ABC17-L	ABC24	ABC17	ABC21-L	ABC17-L	ABC24	ABC17	ABC21-L	ABC17-L
ND	70.28	68.98	69.87	65.48	62.61	56.88	63.98	66.21	69.62	80.85	71.46	80.85
BASE	77.06	75.43	76.85	71.68	67.90	61.12	69.46	71.27	73.01	83.31	74.77	83.31
TEST	65.51	63.57	64.62	59.52	56.69	51.87	57.92	62.43	63.87	74.59	66.50	74.59
DI	60.50	59.20	59.93	54.96	51.44	43.77	52.82	56.71	65.11	80.39	67.83	80.39
Control	58.93	57.74	58.74	54.19	51.24	43.49	52.45	57.13	65.11	82.50	68.74	82.50

Dx16	ABC factor means according to ABC Scale - Dx16 Profiler Outcomes											
group /subgroup	ABC Factor 1: Study Efficacy				ABC Factor 2: Engagement				ABC Factor 3: Organization & Planning			
ABC Scale->	ABC24	ABC17	ABC21-L	ABC17-L	ABC24	ABC17	ABC21-L	ABC17-L	ABC24	ABC17	ABC21-L	ABC17-L
ND	70.28	68.98	69.87	65.48	62.61	56.88	63.98	66.21	69.62	80.85	71.46	80.85
BASE	76.64	75.12	76.41	71.45	68.56	62.33	69.98	71.91	72.97	83.39	76.64	83.39
TEST	64.68	63.47	63.92	61.07	58.29	54.18	59.18	63.35	69.51	80.18	72.13	80.18
DI	60.50	59.20	59.93	54.96	51.44	43.77	52.82	56.71	65.11	80.39	67.83	80.39
Control	58.66	57.46	58.21	53.86	51.36	44.11	52.97	56.62	65.59	81.82	68.55	81.82

Table 29: Comparison of ABC Factor Means for all ABC Scales; subgroups established from Dx20, and Dx16 Profiler Scales.

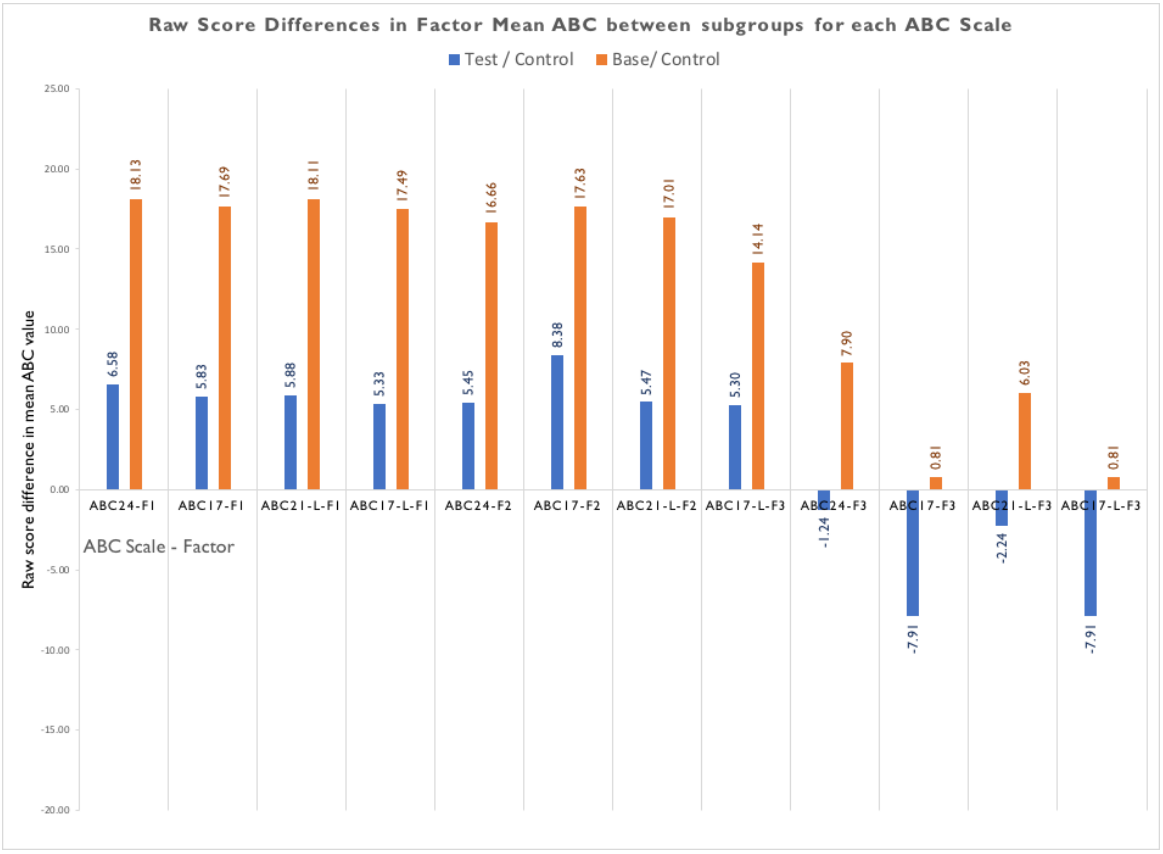


Figure 21: Raw score differences in ABC factor means as defined by the Dx20 Profiler.

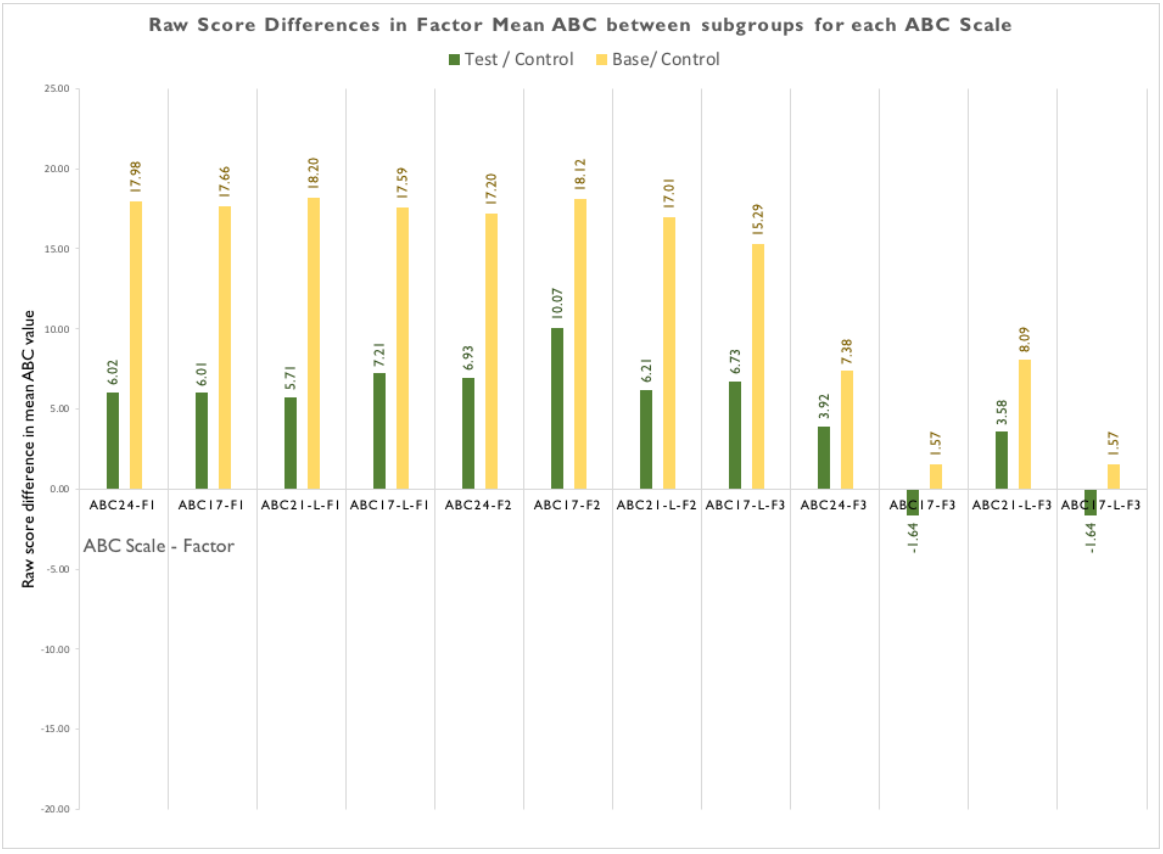


Figure 22: Raw score differences in ABC factor means as defined by the Dx16 Profiler.

ABC Factor Means effect size differences

Converting the ABC factor means raw score differences into effect sizes to take account of sample sizes and standard deviations presented a clearer comparison between the Base, Test and Control subgroups, defined according to Dx20 Profiler outputs (Table 30), and from the Dx16 Profiler (Table 31). (Note that effect sizes between the non-dyslexic (ND) and dyslexic (DI) groups are identical as these are not dependent on which Dx Profiler was used; also, that Factor 3, Organization and Planning, comprised the same ABC dimensions in both of the 17-item scales, ABC17, and ABC17-L, so for this factor, these effect sizes were the same). The greatest effect size (g = 0.6689) between the non-dyslexic and dyslexic groups emerged for Factor 2, Engagement, when their academic confidence was gauged from the ABC21-L, locally derived scale, indicating a moderate-to-large effect size for the group of ABC dimensions that comprised this factor.

Effect sizes between groups, and between subgroups (as defined by the Dx 20 Profiler)				
ABC Factor	ABC Scale	ND <-> DI effect size	Test <-> Base effect size	Test <-> Control effect size
F1: Study Efficacy	ABC24	0.5470	1.0703	0.3473
	ABC17	0.5443	1.0325	0.3020
	ABC21-L	0.5437	1.0586	0.3091
	ABC17-L	0.6401	1.0741	0.2942
F2: Engagement	ABC24	0.6452	0.9785	0.2908
	ABC17	0.6427	0.8472	0.3848
	ABC21-L	0.6689	1.0446	0.3013
	ABC17-L	0.5379	0.7560	0.2653
F3: Organization and Planning	ABC24	0.2576	0.4205	-0.1092
	ABC17	0.0234	0.0435	-0.4121
	ABC21-L	0.2081	0.3564	-0.1287
	ABC17-L	0.0234	0.0435	-0.4121

Table 30: Effect size difference in ABC factor means between non-dyslexic (ND) and dyslexic (DI) groups, and between subgroups as defined from the Dx20 Profiler.

Effect sizes between groups, and between subgroups (as defined by the Dx 16 Profiler)				
ABC Factor	ABC Scale	ND <-> DI effect size	Test <-> Base effect size	Test <-> Control effect size
F1: Study Efficacy	ABC24	0.5470	1/0997	0.3273
	ABC17	0.5443	1.0641	0.3231
	ABC21-L	0.5437	1.1021	0.3099
	ABC17-L	0.6041	1.1099	0.4184
F2: Engagement	ABC24	0.6452	1.0409	0.3847
	ABC17	0.6427	0.8862	0.4724
	ABC21-L	0.6689	1.0843	0.3561
	ABC17-L	0.5379	0.8601	0.3586
F3: Organization and Planning	ABC24	0.2576	0.4430	0.2375
	ABC17	0.0234	0.0852	-0.0917
	ABC21-L	0.2081	0.3674	0.2247
	ABC17-L	0.0234	0.0852	-0.0917

Table 31: Effect size difference in ABC factor means between non-dyslexic (ND) and dyslexic (DI) groups, and between subgroups as defined from the Dx16 Profiler.

For both Factor 1: Study Efficacy and Factor 2: Engagement, effect sizes between non-dyslexic and dyslexic students were moderate whichever ABC Scale was used, with values ranging from $0.54 < g < 0.67$; this suggests that non-dyslexic students presented substantially higher academic confidence than their dyslexic peers in both their capacity or power to produce strong academic outputs, and also the degree to which they participated in active dialogues with their lecturers and collaborated academically with their peers. However it was notable that less pronounced or negligible differences were observed in areas of organization and planning (Factor 3). As would be expected, all of the differences in Study Efficacy and Engagement were accentuated when comparisons were made between the Base subgroup of students with low levels of dyslexia-ness and their strongly dyslexic peers in the Control subgroup, with an effect size range of $0.76 < g < 1.07$, and $0.86 < g < 1.10$, for subgroups defined from the Dx20, Dx16 Profilers respectively. It is of note that the reduced item Dx16 Profiler generated slightly higher outcomes. Effect sizes between the Base and Control subgroups for Factor 3: Organization and Planning were moderate when gauged with the ABC24 or the ABC21-L Scales, again with very slightly higher values recorded when the Dx16 Profiler was used.

Of greatest interest were differences between the Test and Control subgroups. Whilst differences in Study Efficacy and Engagement were modest, a similar trend in differences was observed with the quasi-dyslexic students presenting higher levels of academic confidence for these two factors when compared with their dyslexic peers. Effect sizes ranged from a low-to-moderate $g = 0.27$ when the ABC17-L Scale and the Dx20 Profiler were used to gauge Engagement, to a moderate $g = 0.47$ for the same ABC Factor, gauged with the ABC17 and Dx16 Scales. Although the sample size of the Test subgroup was small (n=18, Dx20; n=19, Dx16) and hence, inferences from these outcomes must be treated tentatively, this result did appear to add to the evidence presented above (Section 4.4) that quasi-dyslexic students exhibit higher levels of academic confidence in many of the dimensions gauged by the ABC Scale(s) than their identified, dyslexic

peers. It was notable that the greatest contribution to differences in mean levels of ABC overall was from dimensions related to study efficacy and academic engagement. Confidence related to aspects of organization and planning in academic studies indicated few, or negligible, differences between groups and subgroups of students in this study.

4.6 APPLYING MULTIPLE REGRESSION ANALYSIS

Whilst the rationale for conducting regression analysis was not to attempt to create a prediction model between academic confidence and dyslexia-ness per se, it was considered appropriate to use the process to generate expected outcomes for ABC based on Dx inputs, thus enabling comparison with the observed values acquired experimentally from participants in the current study. The rationale was to explore whether a regression analysis might add supporting evidence that quasi-dyslexic students appear to present higher levels of academic confidence than might be expected based on their levels of dyslexia-ness.

In the first instance a simple, linear regression analysis between the full ABC24 Scale and the complete Dx20 Profiler validated a moderate association between ABC and Dyslexia Index with an R^2 value (effect size) of 0.1895 (unbiased R^2 = 0.1853), derived from Pearson's coefficient of correlation, r = 0.4353 (Figure 23). This suggested that lower levels of academic confidence might be expected from individuals presenting higher levels of dyslexia-ness, an outcome that has already been demonstrated as likely based on data from students in this study and the analysis above (sub-sections 4.3-4.6). To contextualize this outcome, seven scatterplots with trendlines were produced for all other combinations of ABC Scales and Dx Profilers (not shown) which indicated broadly similar R^2 values, placing this result towards the upper end of the range (Table 32).

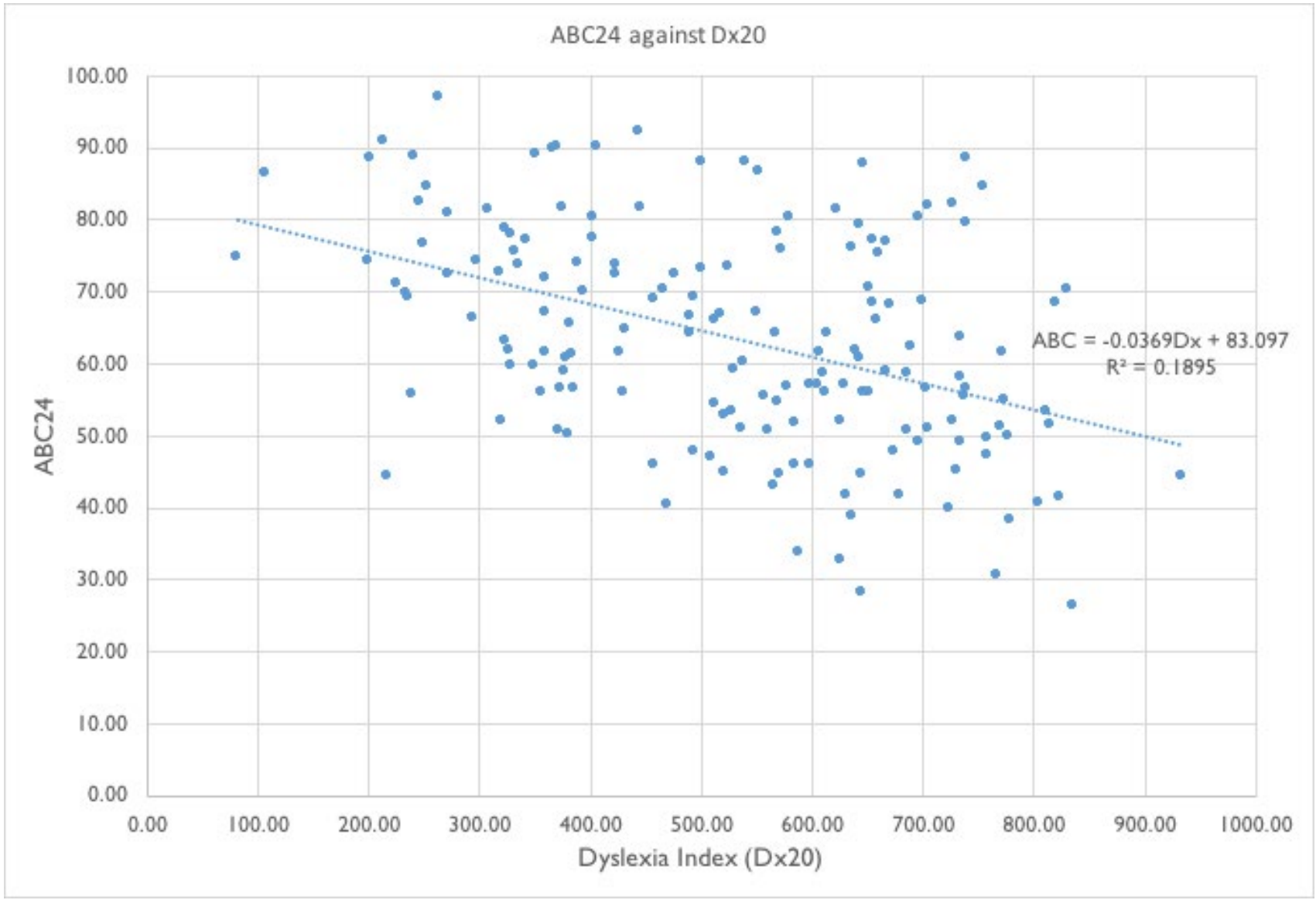


Figure 23: Scatterplot of ABC24 against Dx20 for the complete datapool

Dx Profiler	ABC24	ABC17	ABC21-L	ABC17-L
Dx20	0.1895	0.1946	0.1923	0.1492
Dx16	0.1574	0.1609	0.1600	0.1217

Table 32: Values of R^2 for simple, linear regressions for all permutations of ABC and Dx Profiler Scales.

But the Dx Profilers are multi-item scales so it was reasonable to assume that a multiple regression analysis may generate a better model for the data and hence provide a more accurate mechanism for comparing model-generated, expected mean ABC values with experimentally derived data. However, this study has accommodated four versions of the ABC Scale to analyse data derived from two versions of the Dx Profiler. Hence it was considered that running multiple regression analyses on the eight possible models resulting from permutations of these ABC and Dx Scales would be more appropriately conducted in a subsequent study, with a clear, research design to focus exclusively on this aspect of the possible relationships between academic confidence and dyslexia-ness.

Nevertheless, one multiple regression analysis was conducted using the ABC24 Scale and the Dx20 Profiler, principally as a pilot exercise to determine the feasibility of the processes, to examine whether outputs were meaningful, and hence to indicate whether such a study would be worthwhile. Three multiple regression analyses were conducted to generate distinct regression equations from which four outcomes were of interest:

I - to generate expected ABC24 for all groups and subgroups based on the regression equation derived from Dx20 using data from the complete datapool;

II - to generate expected ABC24 for non-dyslexic students based on the regression equation derived from Dx20 data from that research group;

III - to generate expected ABC24 for dyslexic students based on the regression equation derived from Dx20 data from that research group;

IV - to generate expected ABC24 for students in the Test subgroup, based on the regression equation derived from Dx20 data for the dyslexic group.

In each of the four models the objective was to compare the expected mean ABC24 to the observed mean ABC24 so that the closeness of match could be examined. As this was a pilot for a later, more detailed multiple regression analysis, calculating differences between observed and expected mean ABC values was considered sufficient. A more analytical examination could be developed later as part of an appropriate research design. The greatest interest was in the output for model IV as both cohorts presented on average, similar levels of dyslexia-ness.

The analysis was considered valid as a consequence of preliminary assumptions and tests thus: According to the study design it was considered highly unlikely that observations would be related, confirmed by the Durbin-Watson test for independence of errors (residuals), which generated an output of 1.881. A value close to 2 is considered sufficient to demonstrate this (Lund & Lund, 2016-18). Tests for linearity were conducted by observing scatterplots of the studentized

residuals against the unstandardized predicted values for each of the five regressions. The residuals formed an approximately horizontal band in all scatterplots (not shown), so it was assumed that the independent variables collectively are linearly related to the dependent variable. Homoscedasticity was demonstrated through a visual inspection of the scatterplots of studentized residuals against unstandardized predicted values. Interpretation of correlation tables showed that none of the correlation coefficients were > 0.7 for any of the regression models indicating no evidence of multicollinearity. This was further confirmed by consulting the Table of Collinearity Tolerances where none were less than the recommended critical value of 0.1 (ibid).

Significant outliers were not detected on the basis of standardized residuals being greater than +/- 3 standard deviations (SDs). Consulting the studentized deleted residuals also confirmed the unlikelihood of significant outliers as none were greater than +/- 3 SDs. Checking for any datapoints having undue influence on the regressions showed that 93% of the datapoints presented leverage values of < 0.2, considered the boundary criteria between 'safe' and 'risky' (ibid), with all datapoints < 0.289 leverage. As a further test for influential datapoints, Cook's Distance values were examined and none showed a value >1, considered to be the criteria for testing influence (ibid).

Visual inspection of Normal P-P plots of the regression standardized residuals indicated that the distributions were approximately normal. To test the 'goodness of fit' of the regression models to the data, the proportion of variance explained by each regression model (adjusted R-squared) was I: 43.6%; II: 42.7%; III: 31.6%, suggesting that all models were adequate. To determine the statistical significance of the models, that is, whether they are significantly better at predicating ABC than the mean model, the ANOVA outputs showed that all models returned a statistically significant result.

The mean ABC values calculated from observed data for the complete datapool, each of the research groups and subgroups, was compared with the expected mean ABC values generated from the models (Table 33). Differences between observed and expected mean ABC values are generally small for models used to test their own cohort's data which confirmed the overall validity of the models. For example, the observed mean ABC=58.45 for the dyslexic group is a slim, 0.01 percentage points below the expected mean ABC=58.46 using the regression equation built from this research group's observed data.

Cohort	Observed mean ABC24	Expected mean ABC24: Model I (datapool)	Expected mean ABC24: Model II (ND)	Expected mean ABC24: Model III (DI)	Differences: ABC24 observed - expected
Datapool	63.62	63.56			+0.04
Non-dyslexic group (ND)	67.21	66.54	(67.15)		+0.67, (+0.06)
Dyslexic group (DI)	58.45	57.47		(58.46)	+0.98, (+0.01)
Base subgroup	72.44	71.91	(72.60)		+0.53, (-0.16)

Test subgroup	61.72	57.47	(58.47)	[55.65]	+4.25, (+3.35), [+6.07]
Control subgroup	58.05	57.84		(57.72)	+0.21, (+0.33)

Table 33: Comparisons of mean ABC24 between observed and expected values according to pilot multiple regression models.

However, the results of particular interest showed that the quasi-dyslexic students presented higher than expected levels of academic confidence whichever model was used. The disparity was greatest with Model IV, which indicated a +6.07 percentage-points, higher-than-expected, average result for these students. Hence, initial evidence from this multiple regression analysis pilot indicated that quasi-dyslexic students appeared to present average levels of academic confidence that were substantially higher than might be expected given their levels of dyslexia-ness. Thus, a subsequent study to conduct a more detailed analysis would be warranted.

5 DISCUSSION

5.1 CONTEXT OF THE ENQUIRY

I SUMMARY

The selection of literature reviewed above (Section 2), demonstrated that recent research interest in academic confidence in adult learners, especially those in higher education, has indicated the importance of understanding more about how students at university engage with their studies. It has been shown that those who are able to tackle with confidence, the curriculum content and assessment processes that are core features of their learning experiences at university, are not only likely to gain higher academic rewards than their less confident peers, but will have enjoyed their time at university, been consistently well-motivated, will have considered their achievements to be worthy recompense for their investments, both in time and financially, and that the complete experience will be of lifetime benefit. Theoretical perspectives were presented which supported the view that academic confidence can be considered as a sub-construct of academic self-efficacy, itself one component from a plethora of attributes that together, serve to regulate human behaviour. Such self-regulation is argued to be derived from multifactorial influences stemming from interactions between intrinsic personal characteristics, the local and wider environment that serves as the domain for the behaviour, and the behaviour itself. This understanding of the ways in which individuals function co-operatively and independently is enshrined in Bandura's Social Cognitive Theory, a model which has been adapted to the domain of education and learning and serves as one of the underpinning theories upon which this research project has been grounded. No studies have been found to date which specifically focus on how academic confidence - as the mediating variable between students' inherent academic capabilities, their learning styles and preferences, and opportunities presented to them at university - is impacted by their feelings of 'otherness' attributable to being members of an atypical group of learners, notably those with dyslexic learning differences.

This research study has been interested in relating this explanation of how we function as people not just to the domain of learning and teaching, but specifically to try to explore how the model accommodates the more atypical learning characteristics and behaviours of communities of learners from minority groups - in this case, students with dyslexia at university. The clearly stated aim was to find out more about how the particular attribute which casts them as 'different', 'othered', and 'labelled' might impact on their confidence when tackling the challenges of studying at university, an environment that remains steadfastly literacy-based, and in which they are inherently disadvantaged. For example, one student in this study captured these experiences, saying:

> "I don't like feeling different because people start treating you differently if they know you have dyslexia, and normally they don't want to work with you because of this". (Respondent #85897154; ABC24=47.33; Dx16=850.90).

Drawing from prior anecdotal and practitioner-observed evidence in university learning development contexts, the objectives of the research were firstly to establish that students with dyslexia do, indeed, present lower levels of academic confidence in comparison to their non-dyslexic peers, and secondly, to determine whether evidence would emerge to support the conjecture that knowing about one's dyslexia might, in actual fact, compound the additional

learning demands relatable to the dyslexia itself. Were this to be established, thence to argue that one remedial course of action may be to adopt an alternative, counter-intuitive approach to current norms for equalizing the learning playing field. At present, these are based firstly on establishing the dyslexia through a 'diagnosis', and secondly by designing and attempting to implement a programme of individualized learning support, grounded in applying 'reasonable adjustments' to teaching and learning engagements for that individual. Paradoxically, those approaches might be said to increase the workload of such students rather than ease their pathways through the rigours of academic study, not least through a regimen of less self-regulated, but more externally directed and supervised learning, which can generate additional demands on time-management, organization and scheduling. Resonating with many comments in this current study, this issue was succinctly put by a dyslexic student from the previous Masters dissertation who said:

> "Going for help with my studies takes up more of my time when I'm already struggling with too much work and not enough time; and it rarely helps as I can't explain why I'm struggling - otherwise I would have just done it on my own in the first place". (Dykes, 2008, Respondent #28);

...and in this current study, a student with a moderate level of dyslexia-ness but with a high level of academic confidence suggested that:

> "[Support] should not just be for one type or group of people such as those with particular learning difficulties. I think that puts many people off as soon as they see the term 'learning difficulties'". (Respondent #71712644; ABC24=86.6; Dx16=542.92).

Hence, evidence has been assembled which firstly indicates an inverse relationship between academic confidence and dyslexia-ness in university students; and secondly, supports the polemic that from an academic confidence perspective at least, students with dyslexic learning differences studying at university may be likely to gain academic credentials more in line with their academic capability were they just left to get on with it as best they can. In this case, the focus of remedial activities at university should be shifted towards changing the means of curriculum delivery and learning assessment, and away from changing the student into one who fits more readily into the more conventional and traditional interpretation of a 'university student' in the UK.

As universities have opened their doors to a much broader spectrum of learners, notably through now well-established widening participation and alternative access schemes, it has become increasingly evident that all students would benefit from a better institutional-level understanding of the impact that individual differences can have on educational engagement, ownership of learning, and hence likely attainment. The learning environments and processes that generally prevail at university are not much informed by psychological knowledge.

Hence, progress towards meeting the aspirations enshrined by UDL for example, has, to an extent at least, been stymied. It is not unreasonable to suppose that a slowdown in the learning development initiatives at university that were beginning to bear witness to the value of greater adaptability and flexibility in curriculum delivery and assessment, are likely to have had the greatest impact on communities of learners who come to university with spectra of learning

profiles and preferences that are atypical. Of these unconventional learners, some are labelled with difficult-to-define learning 'disabilities' which are likely to be dynamic in nature, and not necessarily an objective fact. Strong arguments have been presented to suggest that it is learning institutions that translate broad profiles of learning strengths and weaknesses into difficulties and disabilities, not least through the strongly literacy-based transmission of knowledge, and the traditional, inflexible assessments of how much of it has been retained. This is especially true for learners with dyslexia, (which, it has been shown, is difficult to define), who comprise the most numerous amongst those deemed to be 'disabled' in our universities. Evidence from this current study readily documents some of the frustrations. Resonating strongly with the quotation above from the previous study conducted more than a decade prior to this current research, one participant from the dyslexic group said:

> "... universities provide support with tutorials geared at helping the individual with learning, but somehow they seem to expect that a person understands what they find difficult ... [but] because they have been living with it their whole lives, [they] can't see objectively what is 'wrong' ". (Respondent #87564798; ABC24=49.17; Dx16=783.20);

With another respondent echoing experiences of poor levels of institutional understanding:

> "I think there could be more support for students with learning difficulties. As yet, the dyslexic team haven't been very helpful or supportive" (Respondent #61502858; ABC24=61.88; Dx16=629.90);

... and one of her non-dyslexic peers appeared to indicate unmet, or possibly unrealistic expectations about the learning experiences ahead of her, or at the very least showed a lack of understanding and preparedness for the challenges that university learning would present, and that these were considered not to have been met by an appropriate institutional level response:

> "Ways that studying at university can be improved is by far, to teach students how to learn. We're always taught the content for a specific subject, but has anyone ever taught a student on how to learn?" (Respondent #52289216; ABC24=56.88; Dx16=547.61).

These comments were neither uncommon, nor have been taken out of context, were all drawn from the dyslexic students' group in this current study, and they echoed much of the qualitative data collected in the preceding Masters dissertation. It is regretful that this appears to indicate, anecdotally, and for those students at least, that little, or at best, patchy progress has been made at institutional levels that demonstrates understanding more about how to accommodate more readily the learning development needs of such students.

II Challenges

The challenges facing this research topic have been considerable, notably because the syndrome of dyslexia remains controversially defined, not least because the research surrounding its aetiology and manifestation of the learning differences that are purported to be attributable to it, remain varied, sometimes co-morbid with other disadvantaging learning or physical characteristics, and apparently explainable from several different angles. Furthermore, the

majority of research has involved children, not unreasonably stemming from an educationally desirable response to explain the slow uptake of reading and other literacy skills amongst a sizeable minority of early-years learners. Only elatively recently has research attention widened to include exploring more about the nature of dyslexia in adults, more particularly in adult learners, where a review of a wide range of selected literature, suggested that taking dyslexia to be an information processing difference (a multifactorial condition existing in many learners in varying degrees) would be the most neutral and unbiased perspective to adopt. The multifactorial approach fits well with the BDA's description of what it means to be dyslexic, notably where this adopts the idea of a *continuum* for cataloguing the characteristics and attributes of dyslexia, acknowledging that due to its wide and varied nature, it remains difficult to adopt a binary approach to the existence of an individual's dyslexia. Hence in this current study, the continuous nature of dyslexia as a variable led to the establishment of *dyslexia-ness* as the quantifier, and thus, The Dyslexia-ness Continuum.

This led to the most substantive challenge of the study which was to design a data collection instrument that could gauge dyslexia-ness sensitively, and across a sample of the complete university community. This meant that it had to be able to reliably determine levels of dyslexia-ness but not be a dyslexia screener, which would have had ethical implications were one to have been covertly used to collect data. Drawing from a balance of theory taken from the multifactorial explanations of the dyslexic condition with an interpretation of the prevalence of characteristics (dimensions) of dyslexia noted in practical, university dyslexia-support situations, the Dyslexia Index (Dx) Profiler met its design objectives by providing a realistically dependable and reliable interpretation of research participants' levels of dyslexia-ness, and hence their location along the Dyslexia-ness Continuum. However, and aside from its use in this current study, the Dx Profiler remains unique and untested as a data collection tool, which naturally limits the generalizability of its findings. The concepts upon which it is based being theoretically sound, and following anticipated publication shortly relating its development and use to a wider research audience, it is hoped that the opportunity will arise to refine and strengthen both the Dx Profiler itself, and also the concept of dyslexia-ness which it aims to gauge.

Additional challenges arose through use of the existing but also recently developed Academic Behavioural Confidence (ABC) Scale, and the questionnaires that were designed to measure levels of ABC amongst university students. Although the Scale has been deployed effectively in a range of prior studies, and thus is some years ahead of the Dx Profiler along its development journey, it too warrants further refinement. For example, this might be to acknowledge more readily the local nature of the factor structure of the ABC Scale, where sub-scales that emerged from the dataset-specific interpretation of reliability analysis and data reduction in this current study suggested that accepting a degree of fluidity around its factorial composition should be an important component in understanding its determining characteristics, and hence, what the outcomes from the Scale(s) mean, both locally, and for that interpretation to be more widely generalizable.

But this is surely the nature of all measuring scales and instruments that are attempting to gauge tenuous, psychological and educational constructs that are not overtly measurable. It means that outcomes must be treated cautiously and that either repetitive use of the instruments in highly

similar experimental circumstances, or otherwise careful meta-analyses of a number of studies should be conducted so that such scales can become more robust and dependable. In this current study, this led to outputs being generated from four versions of the ABC Scale, two being existing, apparently standardized versions, and two developed from a local interpretation of factor and reliability analysis. Far from this exposing weaknesses in the study design, it was considered as a strength since outcomes were all broadly similar, taken to indicate that whichever version of the ABC Scale was used, it would be possible to draw generalizable conclusions from the outcomes.

5.2 SUMMARY OF THE OUTCOMES

The data collected in this study were rich and varied, elicited from 80 dimensional statements that participants were requested to apply their best judgement to respond to. The questionnaire was designed to be concise, easy to navigate, interesting and accessible to engage with, and especially easy to record responses through use of innovative range-slider input fields. It has not been possible to estimate a response rate because the process used to publicize the questionnaire and hence recruit participants was twofold, and neither mechanism gauged how many students subsequently chose to take part as a proportion of the number who actively read the summary of the research purpose and the invitation to participate. However, of the 183 questionnaire datasets that were returned, only 17 were discarded through being less than 50% completed. Hence, the questionnaire design parameters were considered vindicated, and the size of the datapool deemed to be sufficient for meaningful outcomes to emerge.

I COMPOSITION OF THE DATAPOOL

The datapool comprised 98 students who did not declare a dyslexic learning difference and 68 who did. Overall, these 166 students were considered to be a reasonable reflection of the composition of university students more generally, as distributions according to study level, domicile and gender were unremarkable in comparison to the national trend (HESA, 2018), although overall, approximately twice as many female students as males took part. Since the analysis was not designed to look specifically for relationships between gender, dyslexia-ness and academic confidence, this bias was not deemed to be of consequence, although as these data were collected, scope for examining whether gender might have an impact on the relationships between academic confidence and dyslexia-ness could form part of a subsequent study. A second, notable exception to the generality of the datapool was indicated by the very small proportion of non-UK students in the dyslexic group, where the ratio of home to non-UK students in the complete datapool was approximately representative of the national distribution. Rather than this being an indication of a low proportion of non-UK students with dyslexia studying at UK universities more widely (which would be an inappropriate conclusion to draw based on the relatively small datapool in this current study), it may be more likely accounted for by assuming that non-UK students with dyslexia were not known to the university's Disability and Dyslexia Service, and hence were not on the Service's e-mail distribution list that was used for recruitment. Assuming that access to the Service's advice, support, guidance and resources would be

primarily driven by acknowledging students with dyslexia who had applied for the DSA through the university, it is no surprise that international students with dyslexia slip are unknown to the Service.

II PREVALENCE OF DYSLEXIA IN THIS CURRENT STUDY

The prevalence of dyslexia amongst university students in the UK (and elsewhere) is notoriously difficult to determine for several reasons. For example, the true proportion may be obfuscated through a reluctance to disclose by some dyslexic students due to perceptions of the likely consequences outweighing the possibly marginal benefits; but also, that the student community is likely to include a significant proportion of unidentified dyslexia. Taken with issues about how dyslexia is defined and thus, how this raises challenges for measuring it, the proportion of quasi-dyslexic students identified in this current study was of no surprise. Indeed, this was exactly the outcome that was anticipated in the foundation stages of designing the enquiry, and is consistent with evidence from earlier studies that dyslexia amongst university students may be under-reported (Richardson & Wydell, 2003; Stampoltzis & Polychronopoulou, 2008), or that a substantial number of dyslexic students in UK HE are only identified after their enrolment at university (Singleton, et.al.,1999; Singleton & Aisbitt, 2001). With all participants levels of dyslexia-ness determined by the outputs of the Dx Profilers, it was heartening to note that the small sub-group of 18 (Dx20) or 19(Dx16) quasi-dyslexic students were identifiable from the group of participants who had declared no dyslexic learning differences. At close to 20% of the non-dyslexic group, this sub-group represented a substantial minority although in absolute terms was still a small sample.

The Dx Profiler was not designed to be a dyslexia screener, but its composition did include a breadth of gauging parameters that would not be misplaced in a screener. So, it is not unreasonable to suppose that of the eighteen or nineteen students comprising this sub-group, a proportion, possibly a significant proportion, may be unidentified with dyslexia. To put this in context the most recent data available from HESA (2016/17) indicated that students in UK HE institutions who disclosed a learning disability accounted for 4.8% of the student population overall. This was the incidence of all 'defined' learning disabilities, which, in addition to dyslexia, includes dyspraxia, ADHD, and Asperger's Syndrome. Although there is currently no mechanism in place in their data collection process for discriminating students with dyslexia as a discrete subgroup of those disclosing learning disabilities, it was indicated that HESA views dyslexia as the most represented subgroup. However, it is important not to consider this apparently significant incidence of quasi-dyslexia in this study as a 'dyslexia fact', because the prevalence of dyslexia amongst university students remains inaccurate, and the 'dyslexia debate' continues to be controversial and to a point, contested (e.g.: Elliott & Grigorenko, 2014). Equally this is a result not to be ignored, nor set aside as a data analysis glitch, because the Dx Profiler which revealed this subgroup of students, demonstrated good, if not strong sensitivity when applied to students in the known dyslexic group, subsequently used as the control.

III THE RELATIONSHIPS BETWEEN DYSLEXIA-NESS AND ACADEMIC CONFIDENCE

This study set out to explore the extent to which students with dyslexia at university are less confident about their academic studies than their non-dyslexic peers. The nature of academic

confidence as a distinct, but related construct to academic self-efficacy has been extensively discussed earlier, validating its theoretical underpinnings. Academic confidence, as a construct that is measurable, emerged from an interest in explaining differences in learning preferences between students on similar academic pathways. Early studies led to the reimagining of the metric to acknowledge a more keenly focused interest on study actions and behaviours as the measurable indicators of students' confidence for tackling the rigours and challenges of university study. Thus, the Academic Behavioural Confidence Scale emerged as a practical means to operationalize and gauge levels of academic confidence amongst university students. Very few studies have been found to date which have used the scale to look at how disabilities impact on academic confidence - at least within the same framework that has defined academic confidence for this current study - and none have taken dyslexia as a specific focus. Whether or not dyslexia, as a difficult-to-define syndrome, should feature on the disability agenda remains a contested point. To adopt a position of relative neutrality, this current study has taken the position that dyslexia is best considered as a multifactorial, information processing difference, but one where many individuals beset with a range of its dominant characteristics in varying degrees, persistently remain disabled by the broadly literacy-based learning environment with which they are striving to engage; this only serves to erode their confidence in tackling their studies at university. This position has been grounded in evidence from the literature reviewed and discussed in Section 2. Hence, the research framework defined academic confidence as a sub-construct of academic self-efficacy; and considered dyslexia from the multifactorial perspective, for which a new metric, the Dyslexia Index Profiler, was introduced to operationalize the extent and levels of individuals' aggregation of characteristics or dimensions of dyslexia, their levels of 'dyslexia-ness'.

From the outset two, clear objectives were established: firstly to establish that students with dyslexia, in whatever form it is defined, consistently show lower levels of academic confidence (as gauged from the ABC Scale) than their non-dyslexic peers; and secondly, to determine whether quasi-dyslexic students' levels of academic confidence might be less severely depressed, hence suggesting that studying in ignorance that the pattern of challenges and difficulties experienced are comparable with the dyslexia envelope, carries with it a reduced impact on their academic confidence.

Meeting the first of these objectives was relatively straightforward, subsequent to the development of a suitable data-gathering instrument. With two clearly demarcated groups of students in the datapool - those who had declared dyslexic learning differences, and those who had not - individual levels of academic confidence were gauged using the ABC Scale and mean average outcomes were constructed for each group. The results affirmed an inverse relationship between academic confidence and dyslexia-ness. That is, higher levels of dyslexia-ness tended to be associated with lower levels of academic confidence. However, it cannot be said from this that dyslexia, or dyslexia-like learning and study characteristics *cause* reduced levels of academic confidence because firstly, the dataset collected was too small to support such a radical claim; and secondly, no attempt was made to control for other factors that may also have a bearing on levels of academic confidence in university students. These could be wide-ranging and possibly include social, cultural or ethnic influences on prior learning experiences and history, or intrinsic personal, psychological factors such as anxiety, self-esteem, predisposition towards

academic procrastination, and so forth, or academic credentials on course-commencement, for example. But this datapool of university students was firstly, considered to be reasonably representative of students more generally, and secondly too small to permit analysis at the micro level required were groups and subgroups reduced in sample size to accommodate the distributions of these other factors. Hence the recommendation for further studies to be undertaken to consider this level of analysis.

In the event, those students with dyslexia presented levels of ABC that were on average nine percentage points lower than their non-dyslexic peers, representing 12-13% lower absolute levels of academic confidence. This was a consistent outcome across the four versions of the ABC Scale. Adjusting values to account for sample sizes and distribution variances, the differences also consistently generated moderate effect sizes, with average ABC values shown to be significantly lower for the dyslexic group. When students were further sifted according to their levels of dyslexia-ness, as determined from outcomes from either of the Dx Profilers used for the data analysis, students from the non-dyslexic group with low levels of dyslexia-ness showed substantially higher levels of ABC in comparison to the control group of dyslexic students with relatively high levels of dyslexia-ness, where the greatest difference of 14.96 percentage points emerged from analysis using the ABC 17-dimension Scale and the 16-dimension version of the Dx Profiler. This appeared to indicate that students with low levels of dyslexia-ness were presenting levels of academic confidence some 20% higher on average than their strongly dyslexic peers (Tables 15, 16; sub-section 4.3/IV.II). At a factorial level, where dimension reduction had indicated two factors relating to the *academic* processes of studying with the third concerned with how these processes were planned and organized, outcomes showed that differences were most notable at the academic rather than the planning levels. Indeed, the data showed that all students in the datapool had similar levels of confidence in their capability to plan and organize their studies to meet their academic challenges, and that dyslexic students in the Control subgroup presented similar average ABC levels to their non-dyslexic peers with low levels of dyslexia-ness in the Base subgroup. For the other two factors of Study Efficacy, and Academic Engagement, differences between these subgroups were significant, with the non-dyslexic students showing much higher levels of ABC (Tables 30-32, sub-section 4.5/V). So it became clear that these two 'academic' factors were the strongest contributors to reduced levels of ABC overall for the dyslexic group.

At the very least, it is argued that these outcomes are cause for reflection about how students with dyslexia engage with their university learning experience, perhaps indicating that the academic tasks and challenges of this learning experienced could be more appropriately packaged and presented. Hence, a logical conclusion is that more could be done to enable equitable levels of academic confidence to be an outcome of initiatives designed to improve the 'lot' for students with dyslexia, especially if these can make them feel less othered, different and disabled. Such initiatives are likely to be of benefit to all students as a result of more accessible and flexible learning situations, that are individually adaptable so that academic performance and achievement are more accurate reflections of their capabilities and learning potential.

IV DIAGNOSING DYSLEXIA: DOES THIS IMPACT SIGNIFICANTLY ON ACADEMIC CONFIDENCE?

An additional focus of this study has been to consider whether there may be evidence that the process of identifying dyslexia in university students (or in their prior learning) is likely to have had an impact on their academic confidence.

It has been argued that the outcome of a 'disability diagnosis' may lead individuals with dyslexia to perceive themselves to be valued less by their peers, or even by society more generally; a characteristic typically associated with stigmatization, and an acknowledgement of the stigma that is reportedly associated with the dyslexia label (Morris & Turnbull, 2007; Lisle & Wade, 2013). It has been suggested that the significant part of these feelings may stem from associating 'diagnosis' with curative treatments, and uncertainty about what they are for or whether they will work. It has been shown in Section 2 that affective responses are known to influence compliance with remedial regimes constructed around the modification of behavioural intentions and actions. Translated into the dyslexia context, it is reasonable to suppose that individuals whose dyslexia is diagnosed to them as a learning disability are likely to experience aversive emotional responses to the fact - perhaps even perceiving dyslexia as an illness without a cure. The negative construction of disability is widespread in society by being frequently associated with a clinical condition (e.g.: Connor & Lynne, 2006, Phelan, 2010). A student's reaction to their new situation could be unpredictable, and may impact on their perceptions of their capacity to study, not least from any lasting issues associated with a reimagining of their self-identity and impact on their confidence more widely. This may be particularly notable when disability has been perceived as imposed, especially if this was unexpected. One student in this current study whose dyslexia was diagnosed as a disability said:

> "[Only] In the first year of my degree I found out I was dyslexic and I was massively traumatised by it. I thought learning would never be the same again due to my learning disabilities" (Respondent #89059542; ABC24=53.25; Dx16=811.71)

In Section 2 it was suggested that the process of identifying dyslexia, the dyslexic 'label' that is the outcome, and especially the manner through which the label is attached to the individual concerned, may be a critical factor in establishing whether the affective response to this knowledge is positive or not. One of the strands of this study is acknowledgement of the stigma that is reportedly associated with the dyslexia label. Notably characterized as the ‘dilemma of difference’, there is a persistent and unresolved debate about the value of attributing labels to individuals with atypical educational needs (e.g.: Norwich, 1999; Warnock, 2005; Terzi, 2005) as discussed earlier. At the time of designing this study, no literature had been found which considered exploring as a variable, the impact of the different ways in which dyslexia is communicated to an individual as a result of a screening or assessment at university. Some studies have examined other psychosocial experiences of receiving an identification of dyslexia, but none appear to have explored the possible significance of *how* individuals were told of their dyslexia, always referring to dyslexia being diagnosed with nothing being found to indicate that the term ‘diagnosis’ had been considered as a likely impactor on an individual's internalization of their new knowledge about their dyslexia. To attempt to gauge this impact through the lens of academic confidence is unique.

Analysis of results showed that students in this study whose dyslexia was diagnosed to them presented a substantially lower ABC when compared with students whose dyslexia was identified,

described or disclosed to them. The outcomes were similar whether dyslexia was diagnosed as a disability or as a difficulty, and it was notable that nearly two-thirds of dyslexic students who participated in this study had been diagnosed with dyslexia, and of those, more than half recalled their dyslexia being described to them as a disability. The absolute difference in average ABC between the subgroup whose dyslexia was diagnosed as a disability and those where dyslexia was identified, disclosed or described as a difference or a difficulty was more than ten percentage points, indicating that amongst the students in this sample at least, the academic confidence of the diagnosed/disability subgroup was depressed by more than 14%. This was a statistically significant difference, and when adjusted to account for sample sizes and variances, showed a moderate-to-large effect size of $g = 0.64$. A deeper interpretation of the results revealed that students whose dyslexia was diagnosed, were, in particular, less confident about attending their lectures, seminars and other university teaching situations, and less confident about engaging with their peers or lecturers when they were there. Such behaviour appears consistent with observations in Cameron's (2016) study of the day-to-day learning lives of dyslexic students at university, which revealed that as members of a class, seminar or lecture in the company of other students, participants often found these learning experiences uncomfortable or threatening, reporting 'fear of speaking out in seminars or discussions' so as not to appear 'stupid or incompetent in some way'; that they all felt 'different from others', 'less able or intelligent' and that they 'didn't belong' in academic spaces. Similar feelings were reported by some dyslexic students in this current study. One participant said:

> "I don't speak in class because I am not very confident in answering questions in case I get them wrong and people laugh" (Respondent #85897154; ABC24=41.54; Dx16=862.79);

... with another reporting the lasting impact of feelings of difference stemming from earlier educational experiences:

> "[In class] I do have to battle with elements of doubt ... particularly influenced by bullying at primary and secondary school to do with 'stupidity' and 'slowness' and my seemingly unrelated comments to topics at the time" (Respondent #87564798; ABC24=49.17; Dx16=783.20);

Another study (Thompson et.al., 2015) established that the majority of participants indicated a greater alliance with the perception of dyslexia as differences in ability than with disability, despite the apparently contradictory finding that many felt encumbered by an identity of dyslexia as a disability in *educational* contexts. In the Thompson et al. study, three distinct identity personae were identifiable: firstly, that of being learning-disabled, where the dyslexia was focused on impairments and deficits; secondly, of being differently-enabled, in which dyslexic individuals were able to focus on their strengths and celebrate their alternative ways of thinking and learning as an asset rather than a liability; and thirdly as a dyslexia-identity construction rooted in social-disablement, where individuals admitted to feeling disabled by the ways in which their conceptualized, diagnosed, disabling factors were transformed into barriers which they felt prevented them from conforming to the aspirations of a society focused on literacy as a marker of ability, achievement and normality. Evidence of these identity constructions also emerged from data in the current study, with multiple examples of all three being received.

Hence, there appears to be a likelihood that the means by which dyslexic students are informed about their dyslexia may be a contributing factor to a measurable, negative impact on their ABC, and by logical deduction, on their academic confidence about approaching their studies at university. What seems clear is that the manner in which individuals make sense of their dyslexia and internalize it into their academic self-identity, and especially how this impacts on their engagement with their learning, is an under-researched area - no other studies were found that took this topic as the focus. It also seems reasonable to suggest that greater effort needs to be made firstly, to recognize dyslexia as a difference rather than as a disability; and secondly, that for definitions of the syndrome and the labelling of individuals with dyslexia to remain apposite in educational contexts, care must be taken about how the dyslexic label is communicated to students. Lastly, we are drawn back to the recurring strand that runs throughout this project, that were learning environments designed and structured in more genuinely inclusive ways, the impact of such learning differences on academic confidence would be at least minimized, perhaps eliminated, as one of the factors that affect confidence in tackling academic studies. Taking this approach is likely to enhance learning quality, and hence likely achievement for students whose learning styles, needs and preferences are atypical.

However, the final part of this discussion is driven by results that appear to suggest that it may be best to leave students considered likely to be dyslexic to some degree, in ignorance of the fact. This is a radical conclusion, and although it is tempered by the small sample upon which the results are based, detailed analysis and re-analysis using all permutations of the metrics used in this study, generated broadly similar outcomes. If subsequent studies produce similar outcomes, it may raise difficult ethical issues relating to disclosure that might have to be resolved. The outcome is based on average levels of ABC from the subgroup of students in this current study categorized as 'quasi-dyslexic'. Whichever versions of the ABC Scale were used to determine these students' academic confidence, and whether their dyslexia-ness was assessed from the 20-item or the 16-item Dx Profiler, this subgroup of students showed higher levels of academic confidence than their dyslexia-identified peers, across twenty of the twenty-four ABC dimensions of the full scale. Of these, dimensions where the greatest effect sizes were noted, were confidence to 'attain good grades' (ABC24.#7), and to 'read the recommended background material' (ABC24.#14). We can relate these specific dimensional differences between the dyslexic and quasi-dyslexic students into SCT theory, and also into the practical realization of academic confidence as Sander's academic *behavioural* confidence. The logical strand that connects Bandura's (1995) broad statement about self-efficacy being an individual's context-specific beliefs about their capability to get something done with Sander's adaptation of this idea into academic (behavioural) confidence is illustrated by these confidence differences in 'attaining good grades,' for example. Identified dyslexic students expressed reduced confidence in this dimension, both measured against their non-dyslexic peers but particularly against quasi-dyslexic students where confidence remained substantially higher than the average ABC level of their dyslexic peers. In one study, Sander and Sanders observed that students' confidence in their capability to perform well academically was affected by later outcomes of their assessments, not least due to setting unrealistic expectations about their academic performance. Hence it is possible to surmise that dyslexic students may attribute both their poor performance and their unrealistic expectations of their ability, to their *identified* dyslexic learning challenges, whereas quasi-dyslexic students

with likely similar learning challenges may not echo similar attributions. Thus, their confidence levels are not as notably depressed when academic expectations are not matched by outcomes.

Effect sizes between quasi-dyslexic and dyslexic students in overall ABC were small - but not negligible - when the Test subgroup of quasi-dyslexic students was determined by outcomes from the full Dx20 Scale. When the reduced, Dx16 Scale was used as the subgroup sieve, effect sizes were higher, falling well into the 'moderate' category (Tables 15, 16; Section 4.3/IV(II)). Although significant differences were not detected, some outcomes were marginal. In terms of absolute mean ABC levels, values for this subgroup were squarely between those for the Base subgroup of non-dyslexic students with low levels of dyslexia-ness and the Control subgroup of strongly dyslexic students. At the factorial level, it became clear that the major influences on effect size differences in ABC between the Test and Control subgroups emerged from the two academic process factors of Study Efficacy and Academic Engagement, with negligible differences noted for Organization and Planning.

Assuming that these quasi-dyslexic students would emerge as dyslexic following a standardized dyslexia assessment, this outcome appears to suggest that knowing about being dyslexic is an impacting factor that depresses academic confidence. It is not likely to be the only impacting factor, however, as if so, it would be expected that these students' academic confidence would not be dissimilar to levels for the non-dyslexic group overall, which it was not. Indeed, the tentative regression analysis conducted more as a pilot for future studies than as a major contributor to the analysis outcomes for this current study also indicated that for the students in this datapool at least, the quasi-dyslexic subgroup presented higher than expected levels of academic confidence which although might be thought of as marginal, was nevertheless, not negligible or to be dismissed as a natural variation of the data.

These outcomes suggest firstly, that a more detailed analysis of individual differences in ABC levels at a dimensional level is worthy of investigation, but more so, that future studies are warranted so that the academic confidence of quasi-dyslexic students can be assessed, compared, and subsequently aggregated with the results established here. From this, perhaps a clearer indication may emerge about the extent to which dyslexia is to be considered as a significant impactor on academic confidence, and about whether the identification of dyslexia in university students might actually be counter-productive.

6 CONCLUSIONS AND REFLECTIONS

6.1 SUMMARIZING THE PURPOSE OF THE RESEARCH …

… AND REFLECTING ON THE WIDER IMPLICATIONS

This study has focused on trying to understand more about how the academic confidence of university students with dyslexia may be affected by their dyslexia. The research stems from a desire to apply scientific process to anecdotally observed evidence about how dyslexic students tackle their studies in comparison to their non-dyslexic peers. At two different university settings in my professional positions as an academic guide, experience of working with both groups of students to develop their learning (and meta-learning), indicated that considerable differences exist in attitudes and behaviours in relation to academic study.

It is acknowledged that these can arise through a variety of individual circumstances and learning situations, both current and historical. However, the learning difference of dyslexia uniquely sets apart a substantial minority of students from their mainstream peers as a consequence of the ways that their dyslexia impacts on their academic studies, not least in comparison to learning impacts attributed to other minority-group characteristics, such as ethnicity, social class or cultural differences. This is because dyslexia presents unique challenges in literacy-based education systems, challenges which are based on the assumption that dyslexia is fundamentally an issue associated with literacy capabilities. The evidence for this is substantial, and not a point of specific argument in this thesis. However, there is also considerable evidence that in high-functioning adult learners, as typically seen at university, many of the earlier literacy challenges inherent to a dyslexic individual's learning processes may have been strategically ameliorated, leaving other dimensions of dyslexia to emerge, potentially to have a greater impact on actions and behaviours in academic study.

Many learners face issues that appear to be directly related to their approaches to their academic challenges (Klassen, 2006). Examples have been cited in the literature review above, but Klassen's view, which resonates with the themes in this project, is that poor confidence can be the source of many learning challenges, because academic confidence is the bridge that connects an individual's self-efficacy beliefs to their absolute performance in an academic task. This is important because it implies that academic confidence is a constituent, success-forecast component of the processes that students go through from facing a specific academic task demand to the academic output that is the endpoint.

This process is likely to be partly a function of metacognitive knowledge and partly a function of intrinsic capabilities. In Section 2 it was shown that significant earlier studies have explored these ideas in dyslexic students: For example, that dyslexic students struggle with analysing task requirements, and they often focus on lower-skill competencies such as spelling and grammar, while not recognizing the need for organizational capabilities or writing in a particular register (Butler, 1998, 1999); and that dyslexic students can be less metacognitively aware than their non-dyslexic peers, where this may be more of a manifestation of dyslexic students' knowledge, or perhaps merely perception, that both their own, and maybe more significantly, external expectations of the quality of their academic output is reduced (Tunmer and Chapman, 1996). These feelings may be driven by the stigma associated with the disability label (Ho, 2004), but

also by reduced levels of confidence (in comparison to their peers) about how successful their approaches to meeting the immediate challenges of studying at university will be.

Some of the outcomes of this current study suggest that these characteristics may not be unique to students with dyslexia, where evidence has been presented to indicate that many students find organizing, managing and judging the complexity of their academic workload to be challenging. Previous studies indicated that reduced expectations may be a consequence of experiences in earlier learning, where dyslexic students built perceptions that less was being demanded of them academically, or worse, that educational opportunities were being denied to them because of their dyslexia (Shifrer, 2013; Shifrer et al., 2013; Hornstra et al., 2014). The ABC Scales used in this current study do not explore the relationship between academic *expectations* and academic confidence, and where the full, 24-dimension scale has been shown to be as effective in a reduced, 17-item format, perhaps this spare 'capacity' would encourage a revision that could include dimensions designed to look at students' expectations. This might be a useful development of the scale, and one which would be no more burdensome to complete than the original.

But it is also possible that dyslexic students' *disability status* may have resulted in their prior learning experiences being littered with teachers who misjudged their academic potential by being more focused on managing their apparent disability (Hurwitz et al., 2007). Evidence from the qualitative data collected in not only this current study, but also from the Master's project conducted nearly a decade earlier, suggests that this may persist into higher education where study skills support, well-intentioned as it undoubtedly is, adds to study pressure and anxiety rather than ameliorating it for many students with dyslexia. Furthermore, early evidence suggests that students with dyslexia under-perform in the initial stages of tackling academic assignments by lacking effective means for 'sizing up the task', and hence poorly judge its complexity (Borkowski, et.al., 1989). Although that study was concerned with the issue amongst primary-aged children with dyslexia, it spawned enough subsequent research to suggest a 'Strategy Deficit Model' (Swanson, 1990), as a framework for understanding it, the legacy (and model-development) of which became integrated into similar research amongst the community of individuals with dyslexia (e.g.: Lienemann & Reid, 2006; Bergery, et.al., 2017). But to assume that this is an inherent difficulty that is a consequence of dyslexia excludes the possibility that the way in which the task is framed may make deciphering what to do especially challenging for individuals characterized as neurodiverse thinkers. In other words, for students with dyslexia, the challenges in properly understanding how to tackle an academic challenge, may be more a function of the manner in which the task's academic context is framed as much as any research-reported deficit in meta-cognitive awareness. It is not unreasonable to suggest that any or all of these factors are likely to impact on confidence when tackling learning challenges.

What is especially notable is that several conclusions drawn in this thesis have alluded that many of these issues may be widespread across student communities and not necessarily more prevalent amongst those with dyslexic learning differences. But what does appear to be widespread in dyslexic learners, is the enduring legacy of being ‘othered’ as a result of ‘differences’ in learning contexts, especially where this extends to stigmatization, which consequently has a detrimental impact on confidence for approaching and tackling learning tasks

and challenges. Hence this thesis has attempted to demonstrate that it may be the negative effects that are associated with being identified as dyslexic that may have an abiding effect on depressing academic confidence, which then persists throughout the subsequent, situational learning circumstances - in this case, three or more years of university study. This is despite some signs of a genuine shift towards embracing better inclusivity in teaching and learning, not least through a wider adoption of learning development initiatives. Although these are welcome and well-intentioned, they mostly seem to remain focused on designing remedial activities to upskill the academically weak, disadvantaged or disabled, an observation based my own experience as an academic guide in three university settings over the past decade and more. Indeed, branding services as 'study skills' or 'academic support', may inadvertently reinforce the wider perception that the target audience is the struggling learner rather than as access to learning enhancement for the whole student community. As such, most of the principles enshrined in the concept of Universal Design for Learning, greeted with wide enthusiasm and eagerness as an agent for change in learning and teaching at the turn of the century, remain unadopted. All of which means that regimes at university still tend to be lacking in sufficient flexibility and adaptability to more equally accommodate learning difference, a situation which remains inherently unjust. But this is a topic for future research.

6.2 SUMMARIZING THE RESEARCH OUTCOMES

This research used a self-report questionnaire, completed online, by university students predominantly at one UK institution, to gauge academic confidence and dyslexia-ness. Academic confidence was assessed using the existing ABC Scale developed by Sander and colleagues in the early 2000s with later modifications, together with locally-derived variants. Dyslexia-ness was assessed using an especially-developed Dyslexia Index (Dx) Profiler which framed dyslexia using a multi-factorial approach. By collecting background data about the more general demographical distribution of the students in the datapool, it was established that the sample could reasonably be considered as a typical cross-section of a student community at a UK HE institution.

The data collected permitted two research groups to be established: one group of self-declared dyslexic students, the other, students who declared no known dyslexic learning differences. From these, three subgroups were derived using the criteria of dyslexia-ness established from the output of the Dx Profiler. These were: students with known dyslexia, validated by high levels of dyslexia-ness, (the Control subgroup); students with no known dyslexia validated by presenting low levels of dyslexia-ness, (the Base subgroup); and students with no known dyslexia but who presented high levels of dyslexia-ness, (the Test subgroup).

The research questions asked firstly whether university students who know about their dyslexia present significantly lower academic confidence than their non-dyslexic peers; and secondly whether students who indicated no formally identified dyslexia but who showed strong evidence of dyslexia-like learning and study profiles, present *higher* levels of academic confidence than their dyslexia-identified peers. From these, a further research question emerged which asked whether or not the manner in which students with dyslexia learned of their dyslexia impacted on their levels of academic confidence.

Data from the self-report questionnaire were analysed using a selection of statistical processes which first established levels of reliability of the two metrics for gauging the ABC and Dx of students in this datapool using the Cohen's α coefficient. Although α-levels were high for both metrics, it emerged that some scale item redundancy was present in both scales. Consequently, four variants of the ABC Scale and two variants of the Dx Profiler were developed and applied to the data. Hence, several permutations of ABC outcomes with Dx outcomes became available, and rather than select one as the definitive pair, outputs from all combinations were generated. This was considered a strength of the study because it permitted a range of outcomes to be reviewed in the context of the research questions and hypotheses. This decision was strengthened by generally very similar results emerging, whichever combination of the two metrics were chosen.

In the event, by comparing mean-average data for ABC between the groups and subgroups, it was first established that non-dyslexic students present a substantially and significantly higher level of academic confidence than their dyslexia-identified peers. It was further established from whichever combination of ABC Scale and Dx Profiler variant used, that there was a small-to-medium effect size between ABC means of strongly dyslexic students (Control subgroup) and strongly quasi-dyslexic students (Test subgroup). Although it was not possible to declare definitively these outcomes as significant (according to conventionally defined criteria) they were sufficiently marginal to suggest that further research would be warranted to generate a larger datapool or to assemble data from several studies into a meta-analysis. Hence although the second null hypothesis that there is no difference in academic confidence between dyslexic and quasi-dyslexic students could not be rejected, it is true to report that in all cases, levels of academic confidence across the spectrum was higher for students in the quasi-dyslexic subgroup.

Furthermore, analysis showed a moderate, ABC effect size between dyslexic students whose dyslexia had been diagnosed to them as a disability, and those who were told of their dyslexia in other ways. Thus, suggesting that indicating to students that their dyslexia may be an illness, tacitly implied by diagnosing it, and that the condition also categorises them as disabled, could be a significantly impacting factor that contributes towards reduced levels of academic confidence. This was an expected, and unsurprising result, confirming much of the prior, anecdotal evidence upon which the stance of this project was formulated.

6.3 LIMITATIONS OF THE RESEARCH

To set the objective of identifying quasi-dyslexic students from a cohort of students outwardly declaring no dyslexic learning differences, raised unprecedented challenges. To date, no other studies have been found that attempted such an ambitious task at this level and in this field of educational research. Hence the research design necessarily comprised many elements that were previously untested. These included the design and development of a data collection tool that could be relied upon to identify quasi-dyslexic students sensitively, whilst at the same time not constituting a dyslexia screener; and also the building and deployment of a data collection system that could be delivered to a broad range of participants, recruited into the study

in ways that were unbiased, not skewed, and hence, reasonably representative of the wider community of students at a typical university in the UK. On reflection, it is acknowledged that to attempt a project of such complexity as a sole researcher was probably over-ambitious, and possibly beyond the requirements for study at this level. But the aims of the study emerged from a desire to contribute something of value, that could add to the body of research evidence arguing for a transformation in the ways that students with learning differences - whether categorized as dyslexia or not, itself later shown to be a contentious point - are enabled and empowered to make the most of studying at university.

I SCALE LIMITATIONS

Thus, it is acknowledged that the most critical limitation of the study should be attributed to the design, development and deployment of the Dx Profiler as the discriminator for finding students with quasi-dyslexia. This was an innovative and possibly controversial instrument for gauging dyslexia-ness, itself a term inaugurated in this study. Although an exhaustive process of development, this led to confidence in the Profiler's ability to meet the design objective of this study although it remains untested outside this datapool of students. Nevertheless, and in addition to robust, theoretical underpinnings, an attempt was made to elicit background data from dyslexia study-support professionals working with students in universities across the UK to aid the formulation of the Profiler, even if the response from them was disappointing. With the benefit of hindsight, this process may have been more successful were the purposes and critical value of the data that was being requested to have been communicated more clearly. But in the interests of 'keeping it brief' so as to encourage participation from busy people, it is possible that this action was inappropriately assessed and its importance under-estimated. Hence, one limitation of the Dx Profiler might be attributed to this element of its underpinnings being considered as somewhat flaky, albeit based on strong theoretical reasoning. Although the design intention was ambitious, in execution, and due to a dearth of appropriate background data, this element may have compromised outputs to some extent. For example, the weightings assigned to the Dx Profiler dimensions were derived from data collected through this design development route. Given that the aggregated, dimensional, weighted values constituted the final Dyslexia Index (Dx) for each participant in the study, obtaining the best quality data possible from which to derive the weightings will substantially add to the precision of the final Dx value. Clearly, more data from which to have developed the weightings would have added to the precision of the Profiler.

But these features of the development of the Dx Profiler have been acknowledged throughout the discussion element of this project, and a good attempt to deal with them was demonstrated in the data analysis through statistical devices pitched at strengthening the validity of the Profiler. This was not least through formal scale reliability analysis, which, aside from outcomes suggesting that the Profiler was reliably measuring what it set out to measure, also led to an alternative, abbreviated version being devised and subsequently used in the greater analysis. However, it is also acknowledged that an inherent research weakness of this study may have been introduced because the design and development of the Dx Profiler could have constituted a sizeable project in its own right, and hence has been used in its nascent form. As a consequence, it is possible that this limited development may have resulted in tentative outcomes. These points have also been acknowledged earlier, and it is anticipated that development work on the Profiler can be continued, hopefully following a successful submission for publication, which may also encourage

discussion about not just the idea of dyslexia-ness, but perhaps a wider trial of the tool so that more data can be accumulated and analysed to aid its further refinement.

It is also to be acknowledged that the standardized and relatively well-used ABC Scale is itself, under-developed, which also might contribute to the limited generalizability of the conclusions and outcomes established from its use in this current study. It has been argued that one aspect of this scale's immaturity stems from a concern about the applicability of the standard factor structure of the scale more widely across datasets which do not closely emulate those from which the factor structure emerged. This possibility arose at an early stage of the review of studies that have used the ABC Scale, in that some studies employed the original, 24-item scale, whereas others used the reduced, 17-item version which has a substantially different factor structure. The importance of this lies with the dimensions of the 24-item scale that were removed because it was considered that such a retraction may have been especially datapool-specific, since no wider validation was found. Consequently, both through scale reliability analysis, and dimension reduction simulations (using the Eigenvalue Monte Carlo method), two alternative factor structures for the ABC Scale emerged that were entirely based on the datapool in this current study because the simulation used randomized trials of the data in this study. Together with the two original scales, which were considered to be perfectly usable despite the limitations raised (not least due to the legacy of several prior studies which have used them), this led to four distinct sets of outputs being established, the consequences of which could be argued to have conflated or obfuscated conclusions drawn about students' academic confidence.

This cautious approach was a response to the need for data analysis processes to be as relevant and applicable as possible, and pays more than a passing reference to earlier attention drawn (in sub-section 2.1(VII)) to an example of the reportedly disappointing effectiveness of a construct-evaluating metric developed from a closed cohort sample at a single university, when the metric was used to explore the same construct as presented in a sample taken from a different university's student community (the YAA Adult Dyslexia Scale; Hatcher & Snowling, 2002). In that case, the scale was adapted for use in an Australian university with disappointing results (Chanock et al., 2010) attributed to the limitations of the metric as a result of its development being based entirely on data collected from a single source. The argument followed that this reduced its adaptability for use in outwardly similar contexts but where (as in that case), significant differences in test-subject demographics appeared sufficient to upset the results. In keeping with comments above about the Dx Profiler, the four versions of the ABC Scale used in this current study were considered to be a strength of the analysis process. This was firstly, because the two locally-derived scales were exactly pertinent to the locally collected data, and hence their outputs might be considered as those most likely to reflect the true characteristics of academic confidence of the students in this datapool; and secondly because, as with the two versions of the Dx Profiler considered of equal merit, the simultaneous outputs generated from the same variables could be collectively compared. Hence, both local ABC outputs have also been included in the results and analysed where apposite. There has been neither the time nor scope in this current study to explore the differences and similarities that emerged from ABC Scales' differences in detail - which is considered as a further limitation. Early indications suggest there may be merit in reviewing and more deeply analysing the data, which remains another potential topic for future study.

II DATA COLLECTION, SAMPLING AND DATAPOOL LIMITATIONS; MEASURING ISSUES

Due to the researcher's geographical location, this was a distance-learning study conducted remotely from the data source - namely students attending the same, home university. By its very nature, this advocated the design of a data collection process that could also be conducted remotely. To have adopted an alternative method, such as face-to-face structured interviews, or personally canvassing for participation in a paper-based or electronically-derived questionnaire for example, would have been unworkable. But in different circumstances, either of these alternatives may have been equally productive in terms of the breadth, quality and detail of data that could have been collected. In the event, a great deal of thought, preparation, and prior technical expertise was invested in designing and developing a self-report, electronically-deliverable questionnaire that was technically faultless, attractive to view, easy to navigate, simple to understand, complete, and submit, and not over-burdensome in either time required to complete it, nor the complexity or wordiness of its constituent components. Alternative data collection processes were considered, but given that from the outset this study was designed to be a primary research project where the more data that could be collected was considered the better, adopting a case-study approach for example, where the same research questions might have been meaningfully explored, was dismissed at an early stage. Although data collected could have been high-quality, it would have emerged, by definition, from a highly restrictive and not necessarily representative source. and it was difficult to see how the core, Test subgroup of quasi-dyslexic students may have been established using this approach. Hence, generalizable outcomes were considered less likely to emerge through this methodology. However, it is acknowledged that could such a research design have been formulated, it may have generated outcomes of equal, if less wide-ranging value, that is, with a different, more individually-focused emphasis.

Hence, collecting data through a self-report questionnaire, electronically delivered and submitted was considered the most viable option. Considerable credence was given to pitfalls and limitations attributed to collecting attitudinal data in this way (reported earlier, sub-section 3.3) and attention was paid to accounting for, and designing these out where possible. However, it is acknowledged that such a data collection process brings its own limitations. These include the extent to which participants respond to questions honestly, on their own (without any help, or prompting), in full understanding of the content, structure and purpose of the enquiry - these factors are always beyond the control of the researcher, and hence variability in data quality and response veracity represents a source of potential limitation that will impact on generalizing conclusions. Another limitation is the target audience which, unless specifically selected in advance, is unknown. For the group of dyslexic students this was partially under the control of the researcher as these participants were assumed to be definitely identified as dyslexic by virtue of them being targeted for recruitment through the university's Dyslexia Service e-mail distribution list. But for an individual in receipt of the e-mail invitation to join the study, choosing to participate was entirely voluntary. Hence, it was not possible to devise and access a nonprobability, purposive sample that would have been logically assumed to have been representative of the background population of all students with dyslexia attending the home university. In any case, such a process was precluded by the Service who, certainly at the early stages of scoping the data collection process, were reluctant to be involved in the study at

all, citing potential breaches of confidentiality as the reason, this, despite assurances that data collected through the questionnaire were completely, irrevocably and unconditionally anonymised, with no possible route to trace responses back to an identifiable individual.

Thus, it was not possible to determine the extent to which those who were recruited to the study through this route represented a reasonably random cross-section of students with dyslexia at the university, and so it is possible that outcomes of the analysis were skewed as a consequence. For example it was known that the greater proportion of respondents who were recruited through this route were female, outnumbering males by a factor of three to one. But without privileged access to the gender distribution of students registered with the university's Dyslexia Service (a request for which was submitted but no response received), it was impossible to determine how representative this ratio was, and hence, whether males were disproportionately under-represented. For students recruited into the non-dyslexic group it was at least possible to determine that the distribution of participants by gender was approximately representative of the university student population nationally, as these data were available from HESA for comparison.

The sample size itself was considered as a moderately large (n=166) for a research study of this type, as revealed through the literature review. When the datapool was sifted into subgroups, sample sizes were obviously reduced, although with n=98, and n=68 non-dyslexic, and dyslexic students in each group respectively, these were still considered to be sufficiently large for the outcomes of the data analysis to be meaningful and worthy of interpretation. However, given one of the principal aims of the study was to identify quasi-dyslexic students from the non-dyslexic group, it was known from the outset that the size of the resulting subgroup was likely to be quite small, and that any conclusions drawn would need to acknowledge that small samples are likely to provide evidence for only tentative outcomes. In the event, sifting quasi-dyslexic students out of their parent group led to a Test subgroup of 18, or 19 participants, according to which version of the Dx Profiler was applied as the sieve. Within the limitations of the Dx Profiler as a discriminator, this subgroup represented a substantial proportion of the parent group (18.4%), which, were quasi-dyslexia considered as likely unidentified dyslexia, may suggest the proportion of unknown dyslexia could be as high as nearly one in five apparently non-dyslexic students at university. To draw such a conclusion from this data was considered neither realistic nor tenable, not least as to do so may have been to mis-represent the outcomes of the analysis, not least because the sample is small, and the validity of the discriminator is untested outside this datapool.

6.4 Directions for future research

It is believed that this study is the first to explore specifically the relationship between academic confidence and dyslexia amongst a community of university students.

This was a unique investigation, and further work is required across the domain of higher education to either validate the findings of this current study, or otherwise collect evidence to contradict them. At the same time, the idea of 'dyslexia-ness' needs to be more widely discussed given that in this study it is proposed as a continuum variable rather than a categorical one. It

is used to quantify the prevalence and magnitude-of-influence of a variety of the learning and study characteristics typically associated with dyslexia - but not necessarily absent from apparently non-dyslexic individuals - and especially when the syndrome is taken as a multifactorial, information processing difference.

In the current study, the focus of the investigation has been to explore the legitimacy of relating dyslexia-ness to academic confidence, and further work needs to be conducted to consider whether such an interrelationship is meaningful in higher education contexts; and if so, whether the variables taken together and presented in a relatable fashion (perhaps in some kind of individualized profiling format) can have a useful and productive impact on helping students at university to understand more about their own learning strategies, strengths, and weaknesses. Research designs need to be formulated and executed to determine the extent to which such meta-knowledge can be channelled into guiding students towards removing their learning blockages, and enhancing study strategies so as to be more effective in travelling towards the academic outcomes at university that are a true and proper indicator of their academic capabilities.

Further work needs to be undertaken to develop both of the metrics used in this current study. The ABC Scale, although already established, could be usefully updated to reflect the shifts in teaching and learning regimes at university, for example. Since the scale was originally developed in the early 2000s, learning systems in HE have progressed to reflect greater use of curriculum delivery through electronic and social media applications, perhaps accompanied by a reduction in large-lecture instruction. So the Scale could be adapted to reflect these changes whilst at the same time retaining its underpinning ethos for gauging the effectiveness of students' learning strategies and study behaviours through the lens of academic confidence. Recall that academic confidence has been cited as a significant factor in the self-regulation of learning.

The Dyslexia Index Profiler was developed especially for this project and although it has served the purpose for which it was designed, it remains untested more widely. So in the first instance, it is recommended that more data should be elicited from university dyslexia support professionals so the dimensions that comprise the Profiler can reflect more accurately the prevalence of the characteristics and attributes that they are gauging. Secondly, a wider deployment of the Profiler to a greater range of students at university would enable a better picture to be established of the extent to which all students can be located on the Dyslexianess Continuum. When more data have been accumulated, a deeper investigation of the factor structure of the Dx Profiler could be undertaken, as the data available in this study were only sufficient to hint that a factor structure may be determinable. As a result of likely refinements of the scale, it may be possible to develop a reframing of how dyslexia is understood in adult learners, especially if this can lead to a wider debate about how appropriate or useful it is to formally identify the syndrome. Given that current convention leans towards retaining a process of identification, a deeper exploration of the impact of 'diagnosing' the syndrome is recommended, especially where this subsequently results in dyslexia being defined as a disability to the individual concerned. Perhaps more evidence to support the conclusions of this current study in this respect, might encourage a more widespread uptake in describing dyslexia more neutrally to those identified with it.

Lastly, there remains a considerable quantity of data collected in this study that warrant deeper analysis. For example, at present, assessments of the interrelationships between dyslexia-ness and academic confidence have been mostly confined to the complete scales, although the factor structure of the ABC Scale has been explored and accommodated into the analysis. But outcomes for ABC Scale item dimensions are available, and it would be worth exploring whether the broader differences in ABC that have been revealed between non-dyslexic and dyslexic students in the current study can be more clearly related to specific dimensions of study behaviour as gauged by each dimension in the Scale. Knowing more about this might provide a deeper understanding about how identified dyslexia impacts on learners' confidence when approaching specific components of learning within the wider regimes at university.

6.5 CONCLUDING REMARKS

What do the outcomes of this research say about the academic confidence of students at university? What has emerged about the nature of dyslexia in students at university, and how has this contributed to what is already known about how this substantial minority of learners function and engage with university study? Specifically, what has been revealed about the inter-relationships between these two variables? And has enough been established to speculate, in a reasonably informed way, about how university teaching and learning could be adjusted in the light of evidence presented in this current study?

A primary aim of this project was to explore the academic confidence of non-dyslexic and dyslexic students; an additional aim was to explore the effects that attributing the label of dyslexia to a particular set of learning and study profiles might have on academic confidence. This may be of critical importance in the field of learning design in higher education contexts because by establishing substantial, even significant differences, it may be possible to infer that a reduced likelihood of gaining strong academic outcomes may be at least partially attributable to lower levels of academic confidence, which, as a sub-construct of academic self-efficacy, has been previously reported as a potential marker for academic performance (Honicke & Broadbent, 2016). Hence it would be reasonable to suggest that minimizing impacts that can be shown to depress academic confidence - of which identifying dyslexia maybe one - are likely to have a positive affect on academic achievement.

In short, when it comes to guiding learners towards a good degree at university, this project has established that amongst the community of learners at one university, and based on one reasonably sized datapool, there may be in inverse relationship between levels of dyslexia-ness and levels of academic confidence. The study has also asked whether is it better to label an individual as ‘dyslexic’ or not, and has shown that the answer to this may not be as straightforward as previously imagined. By locating all participants in this study on the Dyslexianess Continuum and attempting to identify a discrete subgroup of individuals presenting quasi-dyslexia-ness, it has been shown that in some cases learning differences that might be attributable to dyslexia, are best left unidentified. It logically follows that for these individuals, and possibly dyslexic students generally, it may be better to remain unaware of their ‘learning

difference’. This may mean that these learners should be encouraged to battle on as best they can within the literacy-based system of curriculum delivery in which they are studying, despite it not being suited to their learning characteristics, strengths and preferences. Even though this approach may be viewed as disproportionately challenging, the costs of undertaking a formal dyslexia assessment, possibly leading to a 'dyslexia diagnosis' may outweigh the apparent benefits of remaining ignorant of the fact. In taking this course of action, controversial as it may seem, there would be no need for recourse to traditional and undoubtedly, well-intentioned ‘reasonable adjustments’, which carry the unfortunate consequence that identifies students with dyslexia as ‘different’ from their peers, leading many to be 'othered' and rejected by their apparently more 'normal' fellow students, especially in co-operative learning initiatives. Evidence for this has been presented throughout this study, from prior literature, from the previous Masters level small-scale study, and from this current research project.

However, it has been shown that dyslexia remains difficult to define because it can comprise a variety of arguably identifiable characteristics which can occur together in multiple combinations; these may not have discrete impacts on learning, and in some cases are comorbid with other conditions or personal circumstances that may be less challenging to define and compensate for. But it has also been shown that some of these profiles of dimensions are observable in non-dyslexic students too. In academically capable individuals, the more conventionally considered characteristics of dyslexia associated with weak literacy skills can have been significantly ameliorated, either through strategically modifying intrinsic approaches to learning, consciously or unconsciously, or through use of external support resources in the form of digital and assistive technologies such as spell-checkers or text-to-speech applications. The outcome is that many of the earlier issues that a dyslexic individual might have faced in their learning history may be less significant than they were. This has been readily demonstrated when dyslexia is considered as a multifactorial learning difference, whereby individuals can present significant levels of dyslexia-ness in some factors but not necessarily in others. It might be argued that all of this merely masks dyslexia, and as a syndrome, it remains as inherently a part of the individual however its manifestations are observable and possibly measurable. But whilst dyslexia continues to be difficult to define, the value to the individual of identifying it, assessing it and somehow quantifying its severity or magnitude of influence, seems dubious.

This leads to an acknowledgement of the view that dyslexia might be best considered as an information processing difference at university rather than predominantly a literacy-skills disability, although the literacy demands of academic study continue to present disadvantageous conditions for many students with information processing differences, because curricula are still broadly delivered and assessed in literacy-based formats. A more appropriate way to repackage dimensions of dyslexia-ness in a contemporary university-learning context may be to consider these characteristics more broadly as academic learning management dimensions, not least because many of them are widely observable across the diversity of university student communities. By characterizing any student’s blend of dimensions through a profile approach, based on a continuum interpretation of dyslexia-ness and academic confidence for example, a better understanding can be gained of strengths and weaknesses. Subsequently, this could be the agent for learning development strategies to be designed and individually-tailored that would capitalize on strengths and ameliorate weaknesses, and hence enhance the effectiveness of

learning, enable students to gain a working understanding of their own meta-learning, and to reflect on how this knowledge about how they learn best can be developed and actioned. This could be a basis upon which comprehensive, personalized learning plans could be developed, which although not a new idea, could be revisited through the lens of dyslexia-ness and academic confidence. Hence, these would emerge as useful not just for students with dyslexia (were it deemed still necessary to formally identify them) but for anyone studying at university. Since academic confidence is “a mediating variable that acts between individuals' inherent abilities, their learning styles and opportunities afforded by the academic environment of higher education” (Sander & Sanders, 2003, p4), gaining a greater understanding of how it impacts on academic outcomes would be a conduit for enhancing these outcomes and creating a more fulfilling and less stressful learning experience. Ultimately this could promote better academic achievements that are more likely to accurately represent individuals' abilities and capabilities. Granted, this may challenge the scope of strategic planning for the future of tertiary-level, high-quality learning, because it may be considered radical and expensive to implement, and may be inhibited by organizational and systemic factors that are resistant to change (Simons et al., 2007).

In short, as universities have opened their doors to a broader spectrum of students through widening participation and alternative access schemes (which have also seen a substantial rise in numbers of students with learning differences choosing to enter HE), it is reasonable to suppose that many of these new faces, together with many of the more traditionally-seen ones, would benefit academically were there a better institutional-level understanding of the impact that individual differences can have on educational engagement and ownership of learning (Conley & French, 2014). Adopting the principles of UDL would meet many of these objectives by ensuring a more accessible, flexible and adaptable learning provision at university that would enable not only students with dyslexia but all students to engage more equitably with learning, using the academic and functional capabilities that they bring to their institutions, unhindered by burdens of judgemental 'difference-identification', or any other potentially marginalizing factor.

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8 APPENDICES

8.1 THE RESEARCH QUESTIONNAIRE (QNR)

The project's research questionnaire was only available electronically. The questionnaire was constructed as a web-based electronic form using Adobe Dreamweaver web-authoring software. Once complete and tested, the questionnaire was hosted on the project webpages where it remains available for inspection[1]. Students who responded to the Invitations to Participate, either directly through the link e-mailed to them by the University's Dyslexia and Disability Service, or from the publicity notice published on the University's student-facing intranet, were taken to the opening page of the suite of questionnaire pages. Explaining briefly the context of the research, this opening page also provided access to the Participant Information Statement and the Participant Informed Consent Statement. Participants were required to acknowledge that they had viewed both of these documents in order to gain access to the research questionnaire.

Listed below are the preliminary pages and the complete questionnaire, reformatted into MS Word so that it can be incorporated into the complete thesis document.

I QNR PRELIMINARY INFORMATION

RESEARCH PARTICIPANT INFORMATION STATEMENT

- You are being invited to participate in a research study but before you decide to take part, it is important for you to understand why the research is being conducted and what it will involve. Take your time to read the following information carefully and discuss it with others if you wish. Please contact the researcher or the researcher's supervisor if there is anything that is not clear or if you would like more information.
- If you decide to take part after reading this information sheet, you will next be asked to give your consent to the data that you provide being used in the research and following that you can access the research questionnaire.
- The research questionnaire is asking about your attitudes towards your learning and your confidence in approaches to studying at university. Your answers will be providing valuable data for the research which is broadly exploring the relationships between academic agency amongst university students and how this is affected by learning differences such as dyslexia or other learning challenges.
- All data that you provide is collected anonymously, you are not asked to identify yourself or provide any contact details and so everything that you report in the questionnaire cannot be attributed back to you as a named person at any time.
- Participation in the research is entirely voluntary and if you decide to take part you can withdraw at any time without providing a reason. Even after you have completed the research questionnaire and sent it, you will still be able to anonymously request that the data you have provided should be removed and erased.
- The research questionnaire comprises a number of question item statements which invite you to judge your level of concurrence (agreement) with them using a Likert-style responder. You should be able to complete the complete questionnaire in about 15-20 minutes. The data that it provides will form part of the analysis to inform the discussion section of the research study, which will conclude with a thesis to be submitted as part of this PhD research project and published on these webpages.
- The ways in which the data will be used together with your rights as a participant are explained in the Research Participant Informed Consent Statement which follows this information sheet.

[1] Available at: http://www.ad1281.uk/researchQNR.html

- The data collection process of this research project has been approved by Middlesex University Education Department Ethics Sub-committee (July 2015) with documentation available for inspection here[2].

PARTICIPANT INFORMED CONSENT STATEMENT

Participant Informed Consent Statement - by moving forward from this page to the questionnaire, it will be assumed that you have agreed to participate in the research and that:

- you have understood that the answers you provide in the questionnaire and the data that is generated will be completely anonymously received by the researcher and not identifiable directly to you;
- you have understood that you have the right to withdraw from participation in the project at any time without any obligation to explain your reasons for doing so;
- you have understood that you can request the researcher to remove and erase any data that your questionnaire reply generates provided your request to do so is received by the researcher before the formal data analysis process begins in January 2016. (Details about how to request removal of data are provided after the questionnaire has been submitted);
- you have understood that the data that your questionnaire reply generates will be used as part of the process of data analysis and will form part of the publication of the research project outcomes, and that as a result of the anonymity of your data as received by the researcher, nothing in any publication can be attributed to your contribution.

[2] a link was provided to the relevant documentation

II THE RESEARCH QUESTIONNAIRE

SECTION 1

Your gender

- please choose… ▼
- female
- male
- prefer not to say

If you have any specific learning challenges that you know about please indicate them here:

- none
- [or] those indicated in this list:
  - dyslexia
  - attention deficit hyperactive disorder
  - attention deficit disorder
  - aspergers syndrome
  - dyspraxia
  - dyscalculia
  - something else

If you ticked 'dyslexia' in the list, please choose from the available options to complete the sentence below to most closely indicate how you learned of your dyslexia:

'My dyslexia was

- choose one… ▼
  - disclosed
  - described
  - identified
  - diagnosed

to me as a learning

- choose one… ▼
  - disability
  - difference
  - weakness
  - strength
  - deficit
  - difficulty

SECTION 2

The first section of 24 questions is asking to think about how ***confident*** you are in various aspects of studying at university

0% = not confident at all <-> 50% = undecided or neutral <-> 100% = very confident

	How confident are you that you will be able to …		% confident
1.01	… study effectively on your own in independent or private study		50
1.02	… produce your best work under examination conditions	["]	…
1.03	… respond to questions asked by a lecturer in front of a full lecture theatre	["]	…
1.04	… manage your workload to meet coursework deadlines	["]	…
1.05	… give a presentation to a small group of fellow students	…	…
1.06	… attend most taught sessions	…	…
1.07	… attain good grades in your work	…	…
1.08	… engage in profitable academic debate with your peers	…	…
1.09	… ask lecturers questions about the material they are teaching in a one-to-one setting	…	…
1.10	… ask lecturers questions about the material they are teaching during a lecture	…	…
1.11	… understand the material outlined and discussed with you by lecturers	…	…
1.12	… follow themes and debates in lectures	…	…
1.13	… prepare thoroughly for tutorials	…	…
1.14	… read the recommended background material	…	…
1.15	…produce coursework of the required standard	…	…
1.16	…write in an appropriate academic style	…	…
1.17	…ask for help if you don't understand something	…	…
1.18	…be on time for lectures	…	…
1.19	…make the most of the opportunity of studying for a degree at university	…	…
1.20	… pass assessments at the first attempt	…	…
1.21	… plan appropriate revision schedules	…	…
1.22	…remain adequately motivated throughout	…	…
1.23	… produce your best work in coursework assignments	…	…
1.24	…attend tutorials	…	…

SECTION 3

Everyone has learning strengths – perhaps creativity is one of yours; challenges – dyslexia for example; and preferences – maybe listening rather than reading. So this next section of 36 statements is asking you to reflect on your profile of strengths, challenges and preferences and judge how they impact on your academic progress and achievement

0% = strongly disagree <-> 50% = undecided or neutral <-> 100% = strongly agree

	To what extent do you agree or disagree with these statements …		%agreement
2.11	I am able to settle down to my work anytime, anyplace		50
2.12	I feel too embarrassed to ask for help with my studies	["]	…
2.13	I feel guilty about my learning challenges	["]	…
2.14	I think my student-peers mostly regard my learning challenges as excuses, for laziness for example	["]	…
2.15	I don't use any of the learning support services because it makes me feel different	…	…
2.16	I don't think about my learning challenges much	…	…
2.21	I find it quite difficult to concentrate on my work most of the time	…	…
2.22	I don't think my learning challenges make me any more anxious than anyone else	…	…
2.23	I use my learning strengths to help me with study strategies	…	…
2.24	I need to work much harder than my friends to get similar grades	…	…
2.25	I often feel frustrated when trying to study	…	…
2.26	I enjoy my studies even more when the work becomes difficult	…	…
2.31	I believe that my learning strengths really make a different to my academic progress	…	…
2.32	I plan and organize my work carefully which I believe helps me to get good grades	…	…
2.33	I don't think my learning challenges make any different to the way I tackle my work	…	…
2.34	I approach my written work with a high expectation of success	…	…
2.35	I believe my learning strengths help me to be more creative or innovative	…	…
2.36	I can manage my studies quite adequately without any help	…	…
2.41	I often felt pretty stupid at school	…	…
2.42	If I try hard, I can achieve just as much as anyone else	…	…
2.43	I think I'm good at studying, perhaps even academically talented sometimes	…	…
2.44	I approach my written work with enthusiasm	…	…
2.45	At times, I think that I'm just hopeless at tackling academic work	…	…
2.46	My contributions in class are usually rubbish, so generally I don't bother	…	…
2.51	When I start a new course or topic, I usually think it will be too difficult for me	…	…
2.52	I've had help for dealing with my learning challenges but it hasn't made any difference	…	…
2.53	I'm generally not surprised when I get a low grade	…	…
2.54	I will always be held back by my learning challenges	…	…
2.55	I think that my grades are as much to do with luck as with any effort on my part	…	…
2.56	However hard I try, this rarely makes a difference to my grades	…	…
2.61	I usually finish my essays or assignments well in time for the deadline	…	…
2.62	I generally put off getting started on my essays or assignments until I really have to	…	…

2.63	For one reason or another, I often have to request extra time to complete my work	…	…
2.64	As soon as I'm given an essay or assignment title, I'm usually eager to get going on it straight away	…	…
2.65	My essays or assignments would probably be better if I didn't have to rush to finish them	…	…
2.66	I often find other things to do rather than working on my studies	…	…

Section 4

The final section of 20 statements is asking you to reflect on other aspects of approaches to your studying or your learning history – perhaps related to difficulties you may have had at school – and also asks about your time management and organizational skills more generally

0% = not confident at all <-> 50% = undecided or neutral <-> 100% = very confident

			% confident
3.01	When I was learning to read at school, I often felt I was slower than others in my class		50
3.02	My spelling is generally very good	["]	…
3.03	I find it very challenging to manage my time efficiently	["]	…
3.04	I can explain things to people much more easily verbally than in my writing	["]	…
3.05	I think I'm a highly organized learner	…	…
3.06	In my writing, I frequently use the wrong word for my intended meaning	…	…
3.07	I generally remember appointments and arrive on time	…	…
3.08	When I'm reading, I sometimes read the same line again or miss out a line altogether	…	…
3.09	I have difficulty putting my writing ideas into a sensible order	…	…
3.10	In my writing at school, I often mixed up similar letters like 'b' and 'd' or 'p' and 'q'	…	…
3.11	When I'm planning my work, I use diagrams or mindmaps rather than lists or bullet points	…	…
3.12	I'm hopeless at remembering things like telephone numbers	…	…
3.13	I find following directions to get to places quite straightforward	…	…
3.14	I prefer looking at the 'big picture' rather than focusing on the details	…	…
3.15	My friends say I often think in unusual or creative ways to solve a problem	…	…
3.16	I find it really challenging to follow a list of instructions	…	…
3.17	I get my 'lefts' and 'rights' easily mixed up	…	…
3.18	My tutors often tell me that my essays or assignments are confusing to read	…	…
3.19	I get in a muddle when I'm searching for learning resources or information	…	…
3.20	I get really anxious if I'm asked to read 'out loud'	…	…

Section 5

Lastly, if you would like to tell me anything else about your learning challenges or strengths, or any other aspects about how you approach your studies at university, you can use the space in this section. I am particularly interested in hearing about ways that studying at university could be improved for you

Write as much as you like, or you can leave this area blank if you have nothing more to add:

NOTES

- A representation of the input-range slider controls is shown. By moving the control to the left or the right of the default, central position, which represented 50%, a number value was recorded between 0 and 100%.
- The sections of the questionnaire were not labelled 1,2, etc because each section was revealed in turn with other sections remaining hidden, achieved using controls on the webpage.
- The Psychometric Scale (Section 3, above) comprised 6 sub-scales of 6 items each which were attempting to gauge respectively:
    - Learning related emotions
    - Anxiety regulation and Motivation
    - Academic Self-efficacy
    - Self-esteem
    - Learned helplessness
    - Academic Procrastination

In the event, data collected from this scale was not used in the Results and Analysis (Section 4) and hence not referred to in the Discussion (Section 5). The reasons for this are presented in sub-section 3.3/III(Section 2 Part 1).

Participants submitted their questionnaire using a control on the webpage which converted the data into tabular form that was automatically sent through e-mail. Simultaneously, the questionnaire was displaced by an Acknowledgement of its receipt which

included a Thank You for Participating, together with an unique, Questionnaire Respondent Indicator (QRI). This 8-figure number was randomly generated by a short script on the questionnaire webpage, was included as part of the questionnaire data submitted, and was devised to enable any participant who wanted to withdraw their data after submitting it to do so. This would have been achieved by following a link on the Acknowledgement page to the Participant Revocation Form, where the QRI could be inserted into a form field. On submitting this form, a further e-mail would be generated and sent, enabling that specific dataset to be removed from the datapool. In the event, no participants followed this process.

8.2 ETHICS APPROVAL DOCUMENTATION

Ethics application and approval documents are inserted as pdf files.

For multi-page documents only the first page is displayed. To display the full document, double-click anywhere on the document image to open the full document in Adobe Reader.

ETHICS APPLICATION AND APPROVAL DOCUMENTS AVAILABLE:

I. Middlesex University Research Ethics Review Form A (Figure 29);
II. Middlesex University Ethics Sub-Committee Request for Research Clarification (Figure 30);
III. Response to Request for Research Clarification (Figure 31);
IV. Middlesex University Form ED17 Ethics Approval (Figure 32);
V. Middlesex University Independent Field/Location Work Risk Assessment Form FRA1 (Figure 32).

I MIDDLESEX UNIVERSITY RESEARCH ETHICS REVIEW FORM A

Middlesex University Research Ethics Review Form A REC ref no:-

*Please read the **MU Code of Practice for Research: Principles and Procedures**[i]. The purpose of this form is to help staff and students in their pursuit of ethical research methodologies and procedures. Students should complete this form in consultation with their supervisors. The **supervisor is responsible for submission**[ii] of this form and required accompanying documents[iii]. **No fieldwork should begin until your Research Ethics Committee (REC) has given approval.***

Section 1 – Applicant details

1.1 Details of Principal Investigator/Supervisor[iv]		
1.1a Name:	1.1b Department/Position:	
1.1c Qualifications:	1.1d Email:	1.1e Tel:
1.2 Details of Student Researcher (if applicable)		
1.2a Name: **Andrew DYKES**	1.2b Programme of study/module: **MPhil/PhD research degree**	
1.2c Qualifications: **B.Ed, M.A, M.Sc, CELTA, FHEA**	1.2dEmail: **ad1281@live.mdx.ac.uk**	1.2e Tel: **07926172026**
1.3 Details of any co-investigators (if applicable)		
1.3a Name:	1.3b Organisation:	1.3c Email:
1.3d Name:	1.3e Organisation:	1.3f Email:
1.3g Name:	1.3h Organisation:	1.3i Email:
1.4 Details of External Funding		

Section 2 – Details of proposed study

2.1 Research project title	**Exploring relationships between dyslexia and academic confidence in HE learning:** Using psycho-social constructs to develop a fresh perspective on the impact of dyslexic learning differences on the academic confidence of HE students.		
2.2 Proposed start date	01 Oct 2014	**2.3 Proposed end date**	30 Sept 2017

2.4 Main aims of the study

The research rationale is to find out how people with dyslexia feel about their learning difference by exploring their judgements of its impact on their learning, particularly in relation to their academic confidence. To quantify this a fresh, innovative profiler for 'the dyslexic self' will be developed which aims to offer an alternative understanding of learning difference in terms of psycho-educational constructs and which does not focus on deficit and disability. The research will be testing the hypothesis that it is the learner's awareness of their dyslexia, rather than the dyslexia itself that is the more impacting factor on their confidence in progressing towards their learning outcomes and academic goals at university. This is thought to be new research and will challenge the persistent medical, deficit model of dyslexia as a disability that requires differentiated support in learning contexts and it is important because relationships revealed may contribute to the emerging discussion on the design of learning development (aka 'support') for groups of learners who feel marginalized or disenfranchised because conventional learning curriculum delivery is misaligned with their learning strengths, or due to their perceived stigma about being labelled as 'disabled' in the social context of learning.

2.5 Details of study design, data collection methods (e.g., interviews, questionnaire, observation etc.) and/or secondary data sources (e.g., UK National Statistics) to be used in the research

The principal research objective is to determine if there is evidence that students who exhibit characteristics of dyslexia but who are otherwise not identified as dyslexic present a significantly different academic (behavioural) confidence (ABC) level in comparison to a group of peers who are known to have a dyslexic learning difference, with both groups' ABC measured against a control group of peers who exhibit no indications of dyslexia as part of their learning profile.
These three research groups are to be referred to as:

- Research group ND: students with no indication of dyslexia;
- Research group DI: students with a dyslexic learning difference that has already been identified;
- Research group DNI: students with a dyslexic learning difference that has NOT previously been identified;

To meet this objective the research analysis is in two parts:

1. The first part of the research focuses on the Locus of Control (LoC) Profiles.

The rationale for the profiles is a legacy of the pilot study because it is realized that a great deal of information is locked up in these collective, graphical representations of feelings and attitudes towards study at university when this is quantified in terms of the five sub-constructs of self-esteem, self-efficacy, learned helplessness, anxiety, regulation and motivation, and learning-related emotions (affective process) used collectively as a marker of locus of control.
In the pilot study (Dykes, 2008), the profiles established are exclusively those of students with a dyslexic learning difference so it is imperative that the LoC Profiles are robustly explored and developed in this PhD project so that they can be confidently used as an indicator of dyslexia likely to be part of students' learning persona. This is because it will be on the strength of LoC Profiles as a discriminator that research group DNI will be established.

Figure 24: Research Ethics Review Form A

II ETHICS SUB-COMMITTEE REQUEST FOR RESEARCH CLARIFICATION

Middlesex University London

School of Health & Education
The Burroughs
Hendon
London NW4 4BT

Main Switchboard: 020 8411 5000

Date: Monday 13th July 2015

HEESC APPLICATION NUMBER: ED17 Andrew Dykes

Dear Andrew Dykes,

Re your application titled: "Exploring relationships between dyslexia and academic confidence in HE learning: Using psycho-social constructs to develop a fresh perspective on the impact of dyslexic learning differences on the academic confidence of HE students."

The Education Ethics Sub Committee has reviewed your application and has been approved subject to the following amendments being addressed. An application that is approved subject to amendments must be returned to Nichole Dunne-Watts (n.dunne-watts@mdx.ac.uk) within 20 working days for consideration by Chairs action or normal review.

Conditions:

2.5 Please clarify how you will identify Research group DI (students with a dyslexic learning difference that has already been identified). Is this through the questionnaires? If so, please explain how this procedure will remain sensitive to those completing the questionnaires.

6.4 Please consider whether there is a moral duty of disclosure towards the participants should indicators of dyslexia be revealed to those who have not acknowledged such indicators. Please explain how the duty of disclosure will be managed in line with the need to minimise psychological distress.

Please cite the application number in all correspondence. You must advise the committee if you are unable to respond to the conditions within 20 working days.

You must not start your research until you have received an ethics approval letter.

Yours sincerely

Dr Mona Sakr
Chair of Education Ethics Sub Committee

Figure 25: Ethics Sub-Committee request for research clarification

III RESPONSE TO REQUEST FOR RESEARCH CLARIFICATION

Andrew DYKES

29 Beacon Way, Park Gate, Southampton, HAMPSHIRE, SO31 7GL

Tel: 01489 55 95 38; Mobile: 079 26 17 20 26; personal e-mail: andrew.dykes@mac.com

PhD Research Student M05006111, School of Health & Education, Middlesex University; student e-mail: ad1281@live.mdx.ac.uk

Dr Mona Sakr
Chair of Education Ethics Sub Committee
School of Health & Education
Middlesex University
The Burroughs
Hendon
LONDON NW4 4BT

Tuesday 14th July 2015

Your Ref: HEESC Application No: ED17 Andrew Dykes M05006111

Dear Dr Sakr

Thank you for your letter of Monday 13th July 2015 detailing the outcome of my application to the Ethics Sub Committee seeking approval for my research to commence.

I respond here to the two issues you raise about my research:

2.5 Please clarify how you will identify Research group DI (students with a dyslexic learning difference that has already been identified). Is this through the questionnaires? If so, please explain how this procedure will remain sensitive to those completing the questionnaires:

This research group will not be identified through the questionnaires. Access to the student database held by the Disability and Dyslexia Service at Middlesex University is being sought from Dr Simon Cassar, the manager of the Service, through discussions with Nick Endacott, the manager of the Learning Development Unit, access to the database of which is also being sought. It is felt that these are the two, simplest gateways that will provide access to student e-mail addresses to enable a direct, e-mail invitation to participate in the e-Questionnaire(s) to be sent out. The question of sensitivity to those completing the questionnaires does not arise as questionnaire responses will not be attributable to any specific individual so the assumption will be made (and outlined in any case in the questionnaire pre-amble) that anyone who has responded by completing the questionnaire is satisfied that their responses are being collected anonymously and by virtue of making the choice to participate in the research, is not sensitive to providing data. This seems reasonable.

Figure 26: Response to Request for research clarification

IV MIDDLESEX UNIVERSITY ETHICS APPROVAL DOCUMENT

Middlesex University London

School of Health & Education
The Burroughs
Hendon
London NW4 4BT

Main Switchboard: 020 8411 5000

Date: Tuesday 21st July 2015

HEESC APPLICATION NUMBER: ED17 Andrew Dykes

Dear Andrew Dykes,

Re your application titled: "Exploring relationships between dyslexia and academic confidence in HE learning: Using psycho-social constructs to develop a fresh perspective on the impact of dyslexic learning differences on the academic confidence of HE students."

I can confirm that your application has been given approval from the date of this letter. Please ensure that you contact the Education Ethics Sub Committee via Nichole Dunne-Watts (n.dunne-watts@mdx.ac.uk) if there are any changes to the study to consider possible implications for ethics approval. The committee would be pleased to receive a copy of the summary of your research study when completed.

Please quote the application number in any correspondence.

Good luck with your research.

Yours sincerely

Dr Mona Sakr
Chair of Education Ethics Sub Committee

Figure 27: Middlesex University Ethics Approval Document

V MIDDLESEX UNIVERSITY INDEPENDENT FIELD/LOCATION WORK RISK ASSESSMENT FORM FRA1

Middlesex University London

INDEPENDENT FIELD/LOCATION WORK RISK ASSESSMENT FRA1

This proforma is applicable to, and must be completed in advance for, the following field/location work situations:

1. *All field/location work undertaken independently by individual students, either in the UK or overseas, including in connection with proposition module or dissertations. Supervisor to complete with student(s).*
2. *All field/location work undertaken by postgraduate students. Supervisors to complete with student(s).*
3. *Field/location work undertaken by research students. Student to complete with supervisor.*
4. *Field/location work/visits by research staff. Researcher to complete with Research Centre Head.*
5. *Essential information for students travelling abroad can be found on www.fco.gov.uk*

FIELD/LOCATION WORK DETAILS

Nam……Andrew DYKES…… **Student No** M00506111
Research Centre (staff only)……

Supervisor …Dr V de Rijke…… **Degree course** ……MPhil/PhD……

Telephone numbers and name of next of kin who may be contacted in the event of an accident	**NEXT OF KIN** **Name** Mrs Sukaina DYKES…… **Phone** ……07716830476
Physical or psychological limitations to carrying out the proposed field/location work	…Middlesex University Campus……
Any health problems (full details) Which may be relevant to proposed field/location work activity in case of emergencies.	……None……
Locality (Country and Region)	……London, UK……
Travel Arrangements	……n/a……
NB: Comprehensive travel and health insurance must always be obtained for independent overseas field/location work.	
Dates of Travel and Field/location work	……n/a……

1

Figure 28: Risk Assessment Form FRA1.