An investigation into Anxiety, Cognition and Performance in Children and Young People

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Submitted by Dana Lee Porter to the University of Exeter as a thesis for the degree of Doctor of Educational Psychology in Educational, Child & Community Psychology.

Signed declaration

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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Abstract

Anxiety has been shown to be associated with lowered academic attainment (Hembree, 1988) yet it remains, to some extent, unsupported in our country's classrooms. Much of the existing literature is correlation in nature and as such does not provide a rich knowledge base from which an Educational Psychologist (EP) can plan for intervention and support. The lack of empirical research also means that understanding how anxiety may disrupt certain academic tasks is unknown. Frick, Silverthorn and Evans (1994) theorized that children with anxiety are not generally recognized due to the lack of externalized behaviour problems which may account for the lack of support and research aimed at supporting these pupils.

This thesis investigated the effects of anxiety on three central executive tasks. A task switching paradigm was used in order to test the prediction made by Attentional Control Theory (ACT). The shifting, inhibition and updating functions were investigated. The results indicated that in certain conditions anxiety leads to a decrease in performance however in other conditions performance was improved. This paper suggests that, in line with much previous research, anxiety has both a positive and negative mediating role on performance. Many of the predictions that are made by ACT were supported by the data. The updating function failed to meet statistical significance though it was suggested that task selection was at least partially responsible.

It is argued that task difficulty, goal setting, focus and motivation are the main catalysts for improved performance. Limitations of the study and future directions for the research is discussed before the findings are framed in terms of their implications for the development of theory and practice for Educational Psychologist.

Chapter One

Introduction

1.1 Purpose

There is a growing body of research that is suggestive of anxiety being attributed to poor educational outcomes. In a meta-analysis of 562 studies of American school pupils, Hembree (1988) reported that elevated anxiety levels were associated with a range of poor educational outcomes and lower academic performance. These included under-performance on ability tests, underachievement in relation to academic grades and, in the longer term, pupils leaving school earlier. There are many other reports of childhood anxiety being associated with lowered academic performance (Ialongo, Edelsohn, Werthamer-Larsson, Crockett and Kellam, 1994; Ialongo, Edhelsohn, Werthammer-Larsson & Kellam, 1995; Woodward & Fergusson, 2001).

Ialongo et al. (1994) suggested an inverse relationship between anxiety and academic performance where children with higher levels of anxiety were approximately ten times more likely to achieve grades in the lower one-third of their class. Similarly, in the United Kingdom Putwain (2008a) reported a negative association between anxiety and GCSE attainment. Other studies highlighted anxiety as being detrimental to not only academic performance but also psychological well being, the development of social skills and the ability to form and maintain relationships (Bernstein, Borchardt & Perwien, 1996).

While the growing body of research suggests that anxiety is disadvantageous to academic performance, not least many other areas of development, there still exists a significant omission in the literature that this research aims to fill. Thus, the purpose of this thesis is to explore and develop a better understanding of how anxiety might influence performance on various academic and cognitive tasks. More specifically, the research aims to identify how cognitive processes and mechanisms are effected by anxiety, on short lasting but resource heavy cognitive tasks for year six pupils aged between nine and ten years old.

1.2.1 Context - Policy

In general terms, the impact of worry and its cognitive component anxiety is becoming a topical point of discussion for educational professionals in the UK. The Every Child Matters Agenda (Department for Education and Skills, 2007) prioritised the importance for all children to be emotionally and mentally healthy. The Cambridge University Primary Review (Tymms & Merrell, 2007) described accounts of increased test-related anxiety due to Standard Assessment Tests (SATs) as reported by the young people themselves in the 'Pupil's Voices' survey. Pupils described being aware of the associated and increased pressures put on them by the SATs and reported that it was discouraging them from learning.

Similarly, The Good Childhood Inquiry (Layard & Dunn, 2009) drew attention to the levels of stress and anxiety experienced by children and young people and in particular, proposed that all Standard Assessment Tests (SATs) should be discontinued as it was thought that the risks to the pupil's psychological wellbeing was greater than the benefits that completing the tests offered. Additionally, Putwain (2008a) argued that issues surrounding anxiety should become even more salient given the heightened performance and accountability pressures, league tables and target setting as required by governmental and educational legislation and policy.

1.2.2 Context – Practice and the Role of the Educational Psychologist

Educational Psychologists (EPs) share a unique role in that they are often regarded as the first point of contact when schools and parents are looking for support when pupils are underperforming. Although practice does vary between services across the country, it is safe to say that EPs, as a profession, are likely to be involved with assessment, identification and support for schools and young people. In practice it is crucial that interventions and support are appropriately tailored to the individual's specific needs, and in a way that promotes the development and maintenance of psychological wellbeing. The literature, as presented above suggests that there may be a link between

performance and anxiety though has yet to establish how this may occur for children with state anxiety.

In Devon, EPs are also involved in many school improvement initiatives and are therefore directly concerned with wider school/ teacher progression and overall performance, accountability and targets such as those mentioned by Putwain (2008a). As such the EP is well placed to shape the theoretical aspects of this thesis into applicable strategies for the needs of their own service. Beyond the immediate needs of the child, the EP will also be crucial for looking systemically at any ways of reducing anxiety and increasing performance, be it through raising awareness, training, school improvement planning or policy making.

1.3 Rationale

The literature concerning anxiety, cognition and performance suggests that there is an association between the two. Yet there is only scarce empirically based research about how anxiety affects academic performance for children and young people, particularly those in elementary school. As such, there are at least three readily identifiable shortcomings of the pre-existing work. Firstly, much of the research that does exist is typically focused on undergraduate students and older secondary school pupils. It may be that anxiety in a younger population is experienced differently than in older children and young adults. Furthermore Educational Psychologists (EPs) as a profession go to great lengths to promote early intervention and as such gathering empirical evidence on a younger population should be beneficial for planning support and early intervention. EPs are ideally placed to spearhead and promote support and preventative measures in order to reduce anxieties that younger children may experience.

Secondly, the majority of research in the area of anxiety and educational achievement has been mostly correlational in nature and lacks any clear pathway towards better understanding how anxiety in younger children might negatively affect cognitive and academic performance (Zeidner, 1998). With EPs being both applied practitioners and researchers the ability to design,

implement and disseminate this proposed work falls uniquely inside their specialist skill set. EPs will also be instrumental in supporting schools with their understanding of the cognitive processes linked to anxiety as well as planning effective intervention strategies at the individual, whole class, groups and systemic levels.

Thirdly, some of the more recent research on childhood anxiety says that children are negatively affected in terms of cognitive abilities (Alloway, Gathercole, Willis & Adams, 2004). However, few studies if any have included a multidimensional measure of anxiety, causality of performance, a guiding cognitive theory such as ACT and tested this in primary school aged children. Traditionally, researchers have used various methods to increase anxiety before or during testing however this is not suitable in research with a younger demographic. Therefore there needs to be a consideration for other ways to investigate the effects of anxiety on performance. A more detailed analysis of the cognitive basis for the impact of anxiety would be unique and beneficial.

Additionally, much of the existing research has been conducted in laboratory settings with clinical populations or from surveys obtained from children who have already experienced academic failure (Mazzone, Ducci, Scoto, Passaniti, D'Arrigo & Vitiello, 2007). The use of older adolescents and young adults or referred participants might be something unique that is not representative of the school population as a whole. This thesis will therefore focus on 'sub-threshold' anxiety. In other words, children and young people who do not have clinical levels of anxiety and who have not been previously identified with any special educational needs but who may still be negatively impacted by it.

It has previously been argued that variation of anxiety symptomology within populations is thought to be better captured using a spectrum approach (Dell'Osso, Saettoni, Papasogli, Rucci, Ciaparelli, Di Poggio, Ducci, Hardoy & Cassano, 2002). On this basis it is hoped that by investigating a non clinical population, without a history of failure or high levels of need, that the ecological validity of the research will be higher, more readily generalizable to the population as a whole and more salient to the classrooms of today. Some of the current research suggests that children and young people are more likely to

experience state anxiety when in school given its transient nature and the demands of the classroom (Gregor, 2011).

It is however uncertain whether or not all children included in the study will show difficulties with cognitive and academic performance. Additionally, by looking at children with no previous history special educational needs it may be that what the previous research was measuring or reporting was actually something different. Furthermore, it may be that the lack of externalized behavioural issues related to children with anxiety has lead to pupils being overlooked despite evidence to suggest a need for support. By considering the data through the lens of the ACT model it is hoped that the research can tap into a larger body of research that has gone into validating the model in many settings using a wide variety of assessments. With this in consideration, there is a clear rationale for the research that is intent on making a theoretical contribution to the field of EP practice and research. It is envisaged that suggestions and guidance offered to support anxious pupils will be presented from a strong theoretical position reinforced by the empirical evidence provided by this research.

Chapter Two

Literature Review

The literature review will start by defining anxiety. The distinction between trait and state anxiety will then be made before touching on the issues of identification and the benefits of a multidimensional approach to anxiety. The review will then shift focus to anxiety and performance before linking in with attentional control theory (ACT), that will be used as a cognitive framework in an attempt to drive the theoretical aspects of the research towards the more practical and applied field. Guided by ACT, current gaps in the literature will be identified and hypotheses formulated to test the theoretical predictions.

2.1 Anxiety: A definition

Anxiety is often recognized as a feeling of fear or worry that an individual has towards something that they perceive as threatening to their goals, self-esteem or person. This feeling is likely to occur before or during a performance or social situation, when there is a perceived emotional risk, physical danger, insecurity or uncertainty (Schwenkmezger & Steffgen, 1989). The experience of anxiety is a complex multidimensional process that often includes a myriad of emotional[1], physiological[2] and cognitive[3] symptoms. Behavioural[4] symptoms are less common and as such can cause anxiety to go unnoticed, particularly in children and young people with non-clinical levels of anxiety (Frick, Silverthorn & Evans, 1994).

[1] The emotional component of anxiety is typically associated with feelings of fear, dread and in its extreme form, panic. If unchecked, anxiety can also lead to frustration, anger, disappointment and sadness.

[2] Physical symptoms of anxiety are frequently described as follows: shortness of breath, rapid heart rate, tightness in chest, shakiness, dizziness, unsteadiness, numbness and tingling, light-headedness, nausea, blushing, feelings of choking and sweating.

[3] Anxiety can disrupt cognition in a variety of ways, many of which will be discussed in this literature review. For a more detailed overview, see The Textbook of Anxiety Disorders (Stein & Hollander, 2002).

[4] Behavioural consequences may include foot taping and avoidance. However in many instances there may be no observable behaviours and as such makes anxiety difficulty to 'uncover' by others.

2.2 Distinction between Trait Anxiety and State Anxiety

There exist two main classifications for anxiety, namely state anxiety and trait anxiety. Trait anxiety reflects a more stable and longer lasting tendency and is generally thought to be more ingrained in one's personality or in their approach to situations. State anxiety is the current experienced level of anxiety that is interactively determined by trait anxiety that is being mediated by situational stress (Eysenck & Calvo, 1992) and as such dissipates quicker. In many cases state anxiety is likened to feelings of tension combined with the heightened arousal of the autonomic nervous system (Harvey, Watkins, Mansell & Shafran. 2004).

Power and Dalgleish (1997) conceptualised anxiety as 'a state in which an individual is unable to instigate a clear pattern of behaviour to remove or alter the event/object/interpretation that is threatening an existing goal'. This conceptualisation accurately depicts some of the empirically based evidence as it relates the consequence of anxiety to cognitive resources being depleted due to the individual worrying about riding themselves of the anxiety provoking thoughts. Grover, Ginsberg and Ialongo (2007) reported that most of these negative automatic thoughts were related to social and peer acceptance. In his investigation he found significant consequences for ones psychological wellbeing, in terms of making good relationships, engaging with others and even future employment prospects. Grover et al. (2007) asserted that anxious individuals were less likely to look for and develop good relationships and social bonds, thereby reinforcing their anxieties.

For the purposes of this thesis, and based on the recommendations of Grover et al. (2007), a multidimensional measure of state anxiety will be used which will include an overall measure of anxiety based on perfectionist thoughts and social anxiety (See section 3.2 for further details).

2.3 Identification

Given the almost complete lack of behavioural symptoms, identifying anxiety in children and young people with non-clinical levels has been challenging. Although there have been many accounts of teachers' awareness of externalized behaviour problems, research on teacher awareness of internalized problems, such as anxiety, was limited (Frick et al., 1994; Barrat & Turner, 2001). Additionally, brief self-report state versus trait anxiety measures were only useful for making categorical distinctions. One could argue that an individual with trait anxiety may not present with any difficulties until put in a stressful or anxiety provoking situation and as such without manipulating anxiety during the 'testing sessions' the participants may not be affected by it. Because of this it was thought that triangulating the data through additional observations and assessment would be a more accurate way to assess. However when setting the research in the body of literature, there was a perceived bias towards anxiety studies involving older adolescents, undergraduates, adults combined with a greater emphasis on clinical populations. This made it difficult to make legitimate comparisons with other research and additionally many measures were not sensitive enough to pick up on some of the difficulties that children and young people were having and when they might be having these difficulties.

Taking up the challenge and in an effort to move the research forward, Bramston and Redman (2001) investigated anxiety ratings where triangulation between children, parents and teachers was compared. The idea was that by having three different ratings that the 'data' would be more robust and accurate. What the authors reported was that they found very little overlap between the three different ratings. In particular, they intimated that teachers reported having no way of knowing about many of the feelings in the children that they taught.

The above paragraphs highlight some of the methodological issues for research of the time. Most studies were cross-sectional in design making it difficult to determine causal relationships between anxiety and performance and how this

developed over the lifespan of an individual (in terms of development, treatment and impact). Where a distinction between state and trait anxiety was useful, it did perhaps not best describe some of the small but significant nuances between anxious states. In order to overcome these methodological limitations multidimensional measures of anxiety were developed that captured a greater range of emotional, physiological, cognitive and behavioural indices. This has two major implications; that findings could be potentially more generalizable given the more accurate account of the anxiety while also helping to broaden the research base into other research areas that may not have been interested in social anxiety, but perhaps performance anxiety.

Muris, Merckelbach, Ollendick, King & Bogie (2002) considered the validity and reliability of multidimensional measures in contrast with assessments that were more unitary (i.e. only making a state or trait distinction) in design. They found that multidimensional measures of anxiety were much more highly connected to current diagnostic systems and as such improved communication about anxiety problems in children. Older state versus trait measures, although demonstrating good psychometric qualities were less sensitive to the variety of effects and nuances that anxiety may cause (Chorpita, Yim, Moffitt, Umemoto & Francis, 2000). Furthermore, some of the measures used were not overly sensitive to fluctuation in anxiety levels. In order to overcome this, some creative accommodations were made.

When investigating anxiety, some researchers would artificially increase anxiety levels before testing so that performance was measured when an individual was likely to be in an anxious state. This brought some ethical considerations as well as concerns surrounding ecological validity, particularly when trying to relate to children and young people in a classroom. In an effort to study anxiety and not breach ethical guidelines, researchers began to shift focus towards test anxiety. This has now been extensively researched and is regarded at the most widely studied form of anxiety in the literature (Zeidner, 1998). However, this route was not completely without shortcomings.

Barret and Turner (2001) first reported the lack of research on children and young people and undertook one of the first investigations into universal test anxiety reduction programmes for school aged children. Using a multidimensional measure of anxiety, Barret and Turner (2001) reported positive results and claimed that interventions aimed at reducing anxiety that were delivered by teachers could be effective at decreasing anxiety in children. However, while the results in terms of reducing anxious symptoms were positive, the authors failed to identify what area of anxiety the children scored the highest in (though they had the data available to them) and therefore delivered a generic intervention without taking into account the specific needs of the children. One could argue that for children with social anxiety, the best outcomes may be those derived from social skills training, or a Circle of Friends type programme. Nonetheless Barret and Turner (2001) showed that they were able to identify the appropriate children using a multidimensional measure and called for more empirically based evaluations and research.

Ergene (2003) followed this up and in a meta-analysis of 56 test anxiety studies. He concluded that there was a serious lack of research into anxiety reduction programmes for primary aged children. It was noted that the literature was biased towards undergraduates and that the data that did exist had a significant amount of variance that went unexplained. Ergene (2003) stressed that given the lack of good data using primary aged children and without a thorough analysis and understanding of the characteristics of the sample population, that developing further interventions should be seen as the secondary endeavour. One could argue that what was being implied was a call for a more homogenous approach to assessment, measurement and even perhaps more clearly delineated implications of anxiety in terms of cognitive performance and outcomes. However Ergene made no mention of whether or not studies were analysed in terms of trait versus state anxiety.

In Zeidner's book, Test anxiety: The state of the Art (1998), it is argued that research often conceptualized the anxious subtype of test anxiety differently. This created a lack of distinction between whether researchers were looking at state or trait anxiety features and because of this, the practical implication for

delivering interventions may differ. Zeidner (1998) also mentioned that one of the outcomes of this failure was that there no shared understanding of the causal affects of anxiety as there is no clear pathway in the literature. In a positive light, however, Ergene (2003) did note that there seemed to be no publication bias in the anxiety literature and that negative results were just as likely to be published as were positive ones. Furthermore, Grover, et al. (2007) also highlighted the importance of assessing anxiety from a multidimensional perspective in order to avoid further conflicting findings.

Gregor (2005) investigated factors affecting test anxiety with an aim to increase schools' understanding of test anxiety and to better support children. It was also reported that Gregor felt the need to conduct the research in order to support the work of EPs as there was little previous published work using the same parameters of the project, namely multidimensional anxiety measures and intervention outcomes based on a focused experimental methodology. Gregor (2005) wrote that the research findings supported the idea that with support academic performance could be restored and that universal school based programmes were both beneficial and cost effective.

2.4 Anxiety and Academic Performance

Gumora and Arsenio (2002), after controlling for multiple variables, such as academic self-efficacy, concluded that anxiety was a good predictor of academic performance with higher levels of anxiety leading to low performance. Consistent with this, Mazzone et al.(2007) found that high levels of anxiety were negatively associated with school grades among children aged 8 to 16 years. Kessler, Foster, Saunders and Stang (1995) presented results from a national comorbidity survey of 8098 respondents investigating the social consequences of psychiatric disorders. The survey indicated that the probability of terminating education during high school was consistently higher for respondents with a prior psychiatric disorder, including anxiety. More recently, Duchesne, Vitaro, Larose and Tremblay (2008) reported that anxiety predicted high school non-completion by the age of 20 in a sample of 1817 children and young people. However, the two above studies were based in the United States and as such,

pupils may have faced different pressures than pupils in the United Kingdom. Certainly, the examination systems, school leaving age and curriculum are different which adds variables to consider when making cross-cultural comparisons.

The difficulty with studies that are predominantly correlational in nature is that one is not able to establish the causal direction of the effects. For example, although it was assumed that higher levels of anxiety lead to poor academic performance, the experiences of children with lower grades and poorer academic performance may also produce similar feelings of anxiety but without the child actually being anxious. Both intervention focused and longitudinal studies have attempted to address this.

A longitudinal United Kingdom (UK) based study by Woodward and Fergusson (2001) explored the relationship between adolescent anxiety and educational achievement. They found that increased levels of anxiety predicted future educational underachievement. Furthermore, Grover et al. (2007) examined the outcomes associated with anxiety symptoms among one hundred and forty nine African-Americans over a seven-year period (mean age at initial assessment was 6 years). The results indicated that high levels of anxiety were associated with significantly impaired achievements in reading and mathematics at the conclusion of the research. After taking into account initial grade differences Grover et al. (2007) concluded that pupils with high levels of anxiety not only had poorer academic outcomes then their non-anxious peers, but their performance worsened in comparison to their peers during the duration of the study's seven-year timescale.

Wood (2006) tested the effects of reducing anxieties in children through the implementation of a cognitive-behavioural intervention. The longitudinal analyses for the forty children aged 6 to 13 years suggested that decreased anxiety over the course of the intervention was associated with improved school performance. In a more recent study, Fonseca, Cury, Fakra, Rufo, Poinso, Bounoua and Huguet (2008) ran a similar intervention using cognitive-behavioural techniques and found that the programme led to reduced anxiety

and enhanced IQ test performance. There are, however, many contradictory findings.

Andrews and Wilding (2004) carried out a longitudinal study exploring the association between mental health problems and academic performance in three hundred and fifty one undergraduate students. They found that self-reported levels of anxiety did not predict subsequent exam performance. However, it is important to note that Andrew's and Wilding's (2004) research sampled an older population than the proposed group for this research and that the literature suggests that executive functions develop across the age range (Brocki & Bohlin, 2004). It may have been that the participants were old enough to have developed sufficient resiliency skills and self regulatory skills and were therefore able to overcome their anxiety. Additionally, many undergraduate based experiments use first year students who may respond differently or experience anxiety or be impacted in a different manner than younger children.

DiLalla, Marcus and Wright-Phillips (2004) also carried out a longitudinal study into parent-rated anxiety of pre-school children and their subsequent academic performance in early adolescence. Their results indicated that early general anxiety predicted better performance at school; this conflicted with their expectations and previous work in the field.

As a general critique there are several possible explanations that could account for some of the conflicting findings. The first could be related to different levels of anxiety being measured, as discussed in section 2.2, and at least one of the catalysts to adopting multidimensional models. It could also be due to the lack of research being conducted with younger children from non-clinical populations. Cognition, like many other things, develops as one gets older and therefore it may be that when comparing younger versus older children that one should expect to see different results. Certainly the understanding of how test results can affect one's life choices changes as children get older. Additionally, as children age, teachers and perhaps adults in general may hold different expectations for young people. This could be particularly relevant in the study by Andrews and Wilding (2004) given the use of an older population having a different understanding of the questions used for the selected anxiety rating

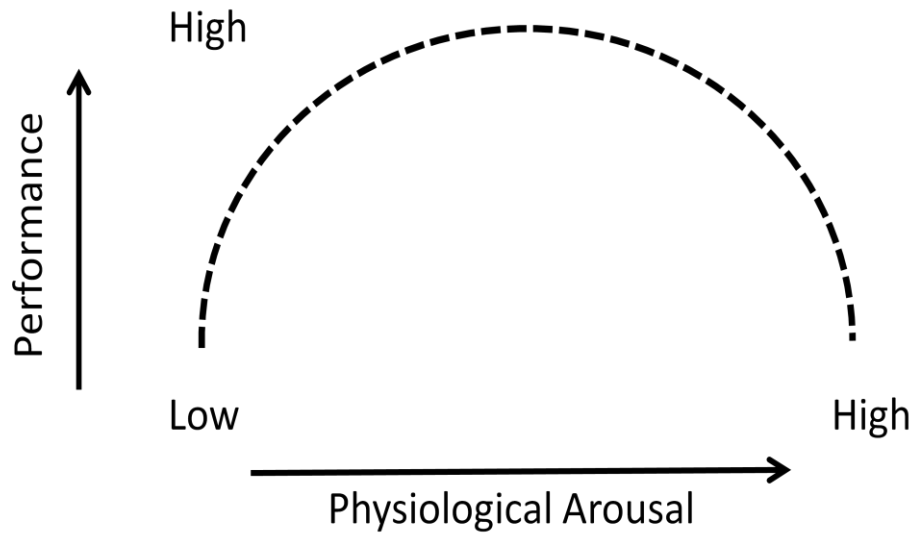
scale. It is also probable that as some children grow older, they may become less anxious as they develop resiliency (Degnan & Fox, 2007). Certainly as discussed earlier the heightened performance and accountability pressures, league tables, target setting as required by governmental and educational legislation and policy and the skyrocketing cost of tuition fees, greater pressures may be being placed on GCSE level students both by themselves and others.

Additionally, many of the studies come from at least two different countries (typically US and UK) that may hold different political, educational and social pressures. There may also be different teacher and parental attributes and beliefs about both education and anxiety that may have been influencing the data, making cross-cultural comparisons at least philosophically incongruous.

2.5 Anxiety and Cognition

In the body of research dealing with anxiety and performance, there are many conflicting findings concerning the impact of anxiety. In some instances anxiety is shown to have a negative effect on performance while other reports demonstrate improved performance when anxiety levels are raised (DiLalla, et al., 2004). An early model, as shown in Figure 1, was developed by Yerkes and Dodson (1908) to explain some of the conflicting findings.

Figure 1. The inverted-U Hypothesis depicting the relationship between arousal and performance (Yerkes & Dodson,1908).



Yerkes and Dodson's (1908) hypothesis suggested that best performance could be achieved with an average, or moderate level of arousal. There is a significant collection of research that clearly demonstrates this inverted-U effect and supports the argument that there is an optimal rather than minimal level of anxiety that most enhances performance (Sarason,1980). Salzberger-Wittenburg, Henry and Osborne (1983) argued that in some cases anxiety could also act as a motivator although were unable to determine this empirically.

Critics of this model, depicting the interplay between performance and arousal, argued that the observed increase in performance was wholly dependent upon task difficulty (Broadbent, 1965). Eysenck and Calvo (1992) argued that much of the inconsistency (decreased versus improved performance) was chiefly due to the conceptual definition of task difficulty. This marked a shift towards more cognition based research to better understand how executive functions were being impaired by anxiety.

Executive function is an umbrella term used to describe the various frontal lobe cognitive processes that afford one the opportunity to respond flexibly to both

learned and novel stimuli/situations. Executive functions are responsible for the awareness and perception of stimuli while also serving to guide reasoning and judgment that directs both psychological and behavioural responses. Cumulatively, they are a system that acts to steer ones reaction to a particular stimuli, event or situation towards a response that best suits the environment, situation and motivational goals by drawing on the individual's previous outcomes and learning.

Eysenck & Calvo (1992) established that the cognitive processes that maintain an anxious state decrease the availability of cognitive resources for executive functions and in particular, working memory (WM). Additionally, Matthews and Mackintosh (1998) suggested that anxiety biases attention, reasoning, and memory thus significantly contributing to poorer outcomes in complex tasks requiring information processing. Several studies have demonstrated that students with WM difficulties have an extremely high risk of making poor academic progress (Alloway & Alloway, 2010; Alloway, 2006; Alloway et al., 2004) and given. The ability to use and mentally manage information is defined as a key function of WM (Alloway, 2006). Superior WM abilities have been shown to positively correlate with academic performance and achievement (Gathercole & Pickering, 2000).

Carroll, Maughan, Goodman and Meltzer (2005) examined relationships between specific academic difficulties and psychiatric disorders in a large-scale national sample (United Kingdom - UK) of children aged 9 to 15. They reported that when background variables and inattentive behaviours were accounted for, depression and attention deficit hyperactivity disorder (ADHD) were not linked with poorer literacy performance. They did however propose casual links between anxiety and specific literacy difficulties. Carroll et al. (2005) also found that children with anxiety were less likely to score highly on reading tests and other assessments that required text to be read and/or used to answer questions. They suggested that anxiety, and specifically social anxiety, as having negative effects on cognitive function whereas other psychiatric disorders did not produce similar results.

Cartwright-Hatton. Tschernitz and Gomersall (2005) also investigated social anxiety in children aged ten and eleven years old. They were interested in determining if students who self reported being poor in social skills would show a real skill deficit or whether it was cognitive distortion (i.e. that anxiety had merely influenced confidence and self-esteem). Cartwright-Hattton et al. (2005) found that the self-reported socially anxious children did not display social skill deficits even when the participants believed that they appeared nervous during social encounters. As a recommendation Cartwright-Hatton et al. (2005) argued that instead of social skills training that a cognitive behavioural measure might be most appropriate and would better address the social anxiety.

More recently, Tysinger et al. (2010) reported a negative correlation between social anxiety and reading comprehension as a measure that predicts academic and employment outcomes. The authors acknowledged that their study should only be considered correlational as they acquired no measures relating to general non-verbal abilities nor did they account for previously existing special educational needs. Furthermore, it was reported that the sample was heavily biased in favour of female participants from a geographically limited area when considering socio-economic and other environmental factors. Nonetheless, the authors were very specific about the social anxiety being the factor most likely to have attributed to the poorer literacy scores due to participants being able to fully concentrate, although this finding was anecdotal.

Additionally, as research on anxiety has progressed and become more clearly defined there appears to be less conflicting findings. With school aged children from non-clinical populations, social anxiety has received significant investigation in many correlational based studies. There is certainly a bulk of literature on social anxiety and reading however empirical based evidence is scarce. Nonetheless, in relation to younger school aged children some of the more consistent findings are coming from the literature on younger children with social anxiety. This is not surprising given the nature and setup of our schools and societal pressure. Additionally pre-teens are often concerned about fitting in with their peers and how they might be perceived.

2.6 Anxiety and Performance Summary

Much of the aforementioned research concludes that anxiety can foster negative educational outcomes for children and adolescents. A longitudinal study by Grover et al. (2007) showed that pupils with high levels of anxiety not only had poorer academic outcomes than their non-anxious peers, but their performance worsened in comparison to their peers over the duration of the study's seven year timescale. It seems therefore critical to gain a better understanding of anxiety in primary aged children. Additionally, there is another distinct gap in the literature pertaining to how one might combat anxiety needs in primary aged children. Much of the existing literature highlights that anxiety results in poorer educational outcomes but many fail to look at how this may be occurring and how this ties in with our theoretical understanding. There are several reasons for this.

Firstly, that a large proportion of the research is based on correlational studies and gives only anecdotal advice. Second, that many research participants involved in cognitive assessments of anxiety performance are undergraduates or older and therefore the literature lacks clarity about how performance might be impacted by anxiety in children and young people. Third, that test anxiety research highlights very mixed conceptualisations regarding the differences between state and trait anxiety. Fourth, only recently have multidimensional measures of anxiety been used and as such only broad generalisations can be made. Fifth, that much of the research into interventions for children focuses on reducing anxious symptoms and often fails to recognize the importance of identifying the subtype of anxiety and then focusing on strategies that develops skills and competencies instead of just dealing with the anxiety.

The literature review has shown two different avenues that research has taken over the recent decade. It seems that in the field of anxiety and performance there is one trend looking towards trait anxiety and cognitive function and another looking at social anxiety and treatment. There is a definitive gap in the literature looking at how social anxiety, a subtype of state anxiety, and cognitive performance are related. Furthermore, an additional gap exists for planning

support and interventions for children and young people with suppressed cognitive performance that is related to state anxiety. In order to frame the research it is crucial that a guiding theory be used.

2.7 Attentional Control Theory (ACT)

Attentional control theory (Eysenck et al., 2007) was developed in response to the limitations of its predecessor, Processing Efficiency Theory (PET) that was formulated by Eysenk & Calvo (1992). Firstly, ACT is based on the assumption that there are two attentional systems that guide the central executive; attentional control being a key function of the central executive. One system is stimulus-directed (bottom-up processing influenced by environmental stimuli) and the other goal-directed (top-down processing influenced by the current goal, expectations and knowledge). Most of the time these two systems interact seamlessly, sharing cognitive resources as required (Yantis, 1998). However, when there is a perceived threat to a goal (i.e. anxiety), attention to the stimulus directed system is increased and the balance is lost (Bishop, Duncan & Lawrence, 2004).

This dysregulation is thought to interfere with inhibition and shifting components of the central executive due to their reliance on attention control (Amir & Bomyea, 2011). Anxiety impedes performance on cognitive tasks by increasing stimulus-driven attentional processing at the expense of goal-directed attentional processing. In other words, instead of maintaining focus on a task, the individual spends their time trying to reduce the anxious symptoms, thereby loosing focus on that task. ACT predicts the outcome, in terms of performance, by stating that the impact is decreased task efficiency[5] with effectiveness[6] being maintained. The mechanisms and how they interact to effect performance have been unclear. Harvey, Watkins, Mansell and Shafran (2004) argue that the cognitive factors that maintain anxiety are biased towards

[5] Efficiency refers to the amount of processing resources invested in doing the task. It is defined by the relationship between performance effectiveness and the use of resources or effort (Eysenck & Deraksham, 2011)

[6] Effectiveness refers to an individual's competence in the actual 'doing' of a task and quality of performance.

sustaining an individual's anxious state. This taxes the cognitive functions and makes processing less efficient (Harvey et al., 2004). In an experiment by Connelly, Hasher and Zack (1991), a task was designed to measure the ability to inhibit attention to distracting information and the effects of this ability on explicit memory performance. The results suggested that anxious individuals have a deficient inhibition mechanism whereby working memory resources are consumed by task-irrelevant distractors. A consequence of this deficiency was that explicit memory performance was poorer for high-anxious individuals. This was thought to be chiefly due to anxiety suppressing the inhibitory functioning of the central executive (Connelly, Hasher, and Zack, 1991). In order to address this Miyake et al.(2000) undertook an empirical investigation of anxiety and executive function.

Executive functioning was systematically tested by Miyake et al. (2000) who proposed three separate functions that have become adopted in updates of ACT (Eysenck et al., 2007). Miyake et al. (2000) referred to these three functions of executive control as inhibition (suppression of irrelevant information from working memory); shifting (shifting of attention to remain focused on task and goal relevant stimuli); and updating (actuated by adding or changing working memory representations). The inhibition and shifting functions are both thought to use attentional control. The updating function is thought to involve storage of information (wm) rather than attentional control. In this regards, anxiety should have a lesser effect on updating when compared to the inhibition and shifting functions (Eysenck et al., 2007). The evidence suggests that the inhibition and shifting functions are independent in their operation while at the same time they are not fully separable (Miyake et al.(2000).Therefore, being able to clearly separate these two effects should only be achieved through an empirical investigation. In order to achieve this Hedden and Gabrieli (2010) used neuroimaging techniques to look at activation in brain regions deemed responsible for inhibition and shifting functions. They found regions activated by both shifting and inhibition functions but also area that were independent of each other.

Based on these finding it becomes crucial to investigate times when both shifting and inhibition are called for. This will require tasks that call for both inhibiting task irrelevant stimuli while at the same time shifting between and within tasks. The practical reason for this is to better conceptualise how interventions could be developed in order to inhibit the unwanted thoughts of worry while then shifting attentional resources back to goal driven behaviours while at the same time away from threatening stimuli.

Finally, in order to compensate for anxiety, ACT predicts that those with high anxiety may feel more motivated to succeed and as such will allocate additional processing resources (self-regulated) to achieve. By doing so, processing efficiency (time taken) is impaired while performance effectiveness (correct answers) is not. Furthermore, ACT predicts that motivation will increase when task goals are difficult but achievable in comparison to more easy tasks. To date, there exists no research testing the role of motivation on high anxiety participants yet it being a central assumption of ACT. Additionally, there has been only limited research conducted empirically investigating this using children with non clinical levels of anxiety. In order to fill this gap in the literature, this thesis will test several of the predictions of ACT using children with non clinical levels of anxiety. In an attempt to be clear, and concise, the following summaries will be numbered so that they will clearly relate to testable hypotheses.

2.8 Summary

Moving forward it may be beneficial to summarise the key assumptions about how anxiety can decrease performance. First, the cognitive component of worry plays a central role in the anxiety-performance link when behaviour is not the primary concern. Secondly, WM plays an important role in linking anxiety and performance. This is based on evidence supporting the view that WM is the factor that best predicts school achievement (Alloway, 2009). Additionally, superior WM abilities have been shown to positively correlate with academic performance and achievement (Gathercole & Alloway, 2000) and as such may act as a tool to be used to combat the effects of anxiety. Thirdly, that the effect

of anxiety is largely on the central executive. This assumption is based on the findings of Derakshan and Eysenck (2009), which also support the fourth and final assumption, that the negative effects of anxiety are predicted to be significantly greater on processing efficiency than on performance effectiveness.

In most research anxiety is seen as a dimension of personality however this investigation will look at the more transient affects (state anxiety). The reasons for this are twofold. First, multidimensional state anxiety measures capture a broader scope than uni-modal trait anxiety measures. Secondly, using a multidimensional measure will enable any findings to be more precise so that any interventions and support may be better targeted. A highly influential model in the area of anxiety and cognition research is ACT. The thesis aims to tests the effects of state anxiety with the major theoretical hypothesis associated with this model as presented by Eysenck and Derakshan (2011).

2.9.1 Predictions and Hypothesis

Prediction 1: Anxiety will impair the efficiency of the central executive.

Hypothesis 1: That the high anxiety group will demonstrate a larger increase in response times on switch trials than the low anxiety group.

Measure Used: Task switching

Prediction 2: Anxiety impairs the inhibition function. Evidence has shown that inhibiting irrelevant stimuli is more difficulty for high anxiety than low anxiety groups.

Hypothesis 2: That the reaction time for incongruent trials will be greater than for congruent trials when the difficulty level is high. A three way interaction between the factors congruency, CSI, trial type and anxiety should be seen. .

Measure Used: Task Switching

Prediction 3: Anxiety impairs processing efficiency more than performance effectiveness

Hypothesis 3: That there would be no statistical difference in error rates for complex switch tasks (switch, non-transparent, incongruent, short CSI) between the high and low anxiety groups.

Measure: Task Switching

Prediction 4: Anxiety has only a limited affect on the updating function as it does not rely solely on attentional control. Therefore ACT predicts that the updating function is less affected by anxiety than the shifting and inhibition functions. It may be that updating functioning is only impaired during stressful situation and as such is difficult to accurately test in most settings. It has however been shown to be negatively correlated with state anxiety in response to stressful situations and this can be achieve through increasing task difficulty for either goal or stimulus directed processing. Testing this executive function can be achieved by looking at the capacity and ability to update information in the working memory.

Hypothesis 4: That task switching will be mediated by simultaneous processing ability and that this will differ between the high and low anxiety group when the task difficulty is high.

Measure: Task Switching and CAS simultaneous processing.

2.9.2 Research Questions

With the area of investigation now framed, the research intends to answer the following questions

1. Do children perform similar to the undergraduate participants who are more frequently used in task switching experiments?

2. Are the predictions made by ACT valid when participants are primary aged school children, when anxiety levels are identified using the MASC and for the chosen experimental design (i.e. non-threatening)?

3. In what ways do high versus low anxiety ranked children differ in their performance in a task-switching paradigm?

4. How does all of this translate and fit into the usual model of EP practice?

The research questions will be address in the result and discussion sections found in chapters 4 and 5 of the thesis.

Chapter Three

Methodology

3.1 Design.

Epistemological Stance.

In order to decide how to address the research questions, it was important to decide on an epistemological stance. A deductive, often referred to as Positivist, approach is typically adopted in quantitative research where one proceeds from theory to data (theory, method, data and findings). A deductive method entails the use of a conceptual and theoretical structure prior to testing through empirical observation. This approach posits that objective knowledge can only be derived from direct observation or experience. It affords the researcher the opportunity to separate themselves from the data thus decreasing the likelihood of either biasing, or being biased by the data (Cohen, Manion & Morrison, 2000). The emphasis is on the ability to use the data, through a sequential analysis[7], to deduce ideas or facts from the new theory in order to provide a more coherent framework than the theories that preceded it.

Methodological Approach.

Methodology is a body of knowledge that enables researchers to explain and analyse methods. The aim is to enable one to indicate limitation and resources, to identify presuppositions, consequences, and relating their potentialities to research advances (Miller, 1983). Methodology refers to how a question, or problems would be best studied (McGhee, 2001). Previous research into children's performance on academic tasks and anxiety has taken a correlation

[7] Robson (2002) formalised the process in five sequential stages through which deductive research progresses as: Deducing a hypothesis from the theory, expressing the hypothesis in operational terms, testing the operational hypothesis, examining the specific outcome of the inquiry, and if necessary, modifying the theory.

approach. A criticism of this approach is that these studies do not suggest causation and may therefore only be suggestive of the relationships that they are trying to unpick.

Directly influenced by the epistemological stance, the ontological approach of this research therefore aligns itself with correlational and experimental quantitative methodology. One of the main arguments concerning previous research in anxiety and performance is that much of the findings are correlational and therefore unable to predict causal links. Correlational research affords the researcher an opportunity to investigate anxiety through looking for naturally occurring variables. When working with children it would be unethical to artificially increase levels of anxiety and therefore correlational research would be, in most cases, more appropriate. Previous studies typically used undergraduate participants. With older participants researchers may be able to 'artificially' create increased anxiety (e.g. a participant who scores highly on a measure of social anxiety being asked to complete a reading measure in from of a group of their peers) whereas this would not be appropriate for children and younger people. Therefore, this thesis will manipulate task difficulty, as a means to tax the executive functioning (as predicted by ACT), thereby seeing if the underlying natural state of anxiety shows any impact on cognitive performance. In effect, where some experiments would increase anxiety and leave the task difficulty unchanged, this investigation will do the opposite and leave the anxiety unchanged but increase task difficulty.

The quantitative approach describes tests and examines cause and effect relationships (Burns & Grove, 1987). The strength of this approach is that the research, and the data derived from it, should provide sufficient information about the relationship between the variables under investigation to enable prediction and control over future outcomes (Charoenruk, 2007). It will also allow for direct comparison with other research as well as being replicable. The nature of this approach should also ensure sufficient levels for both validity and reliability.

3.2 Participants.

Informed written parental consent was obtained for 36 year 5 and 6 pupils from four primary schools in the Southwest of England (Appendix I) whom participated in phase two of this study. The mean age of the participants ranged in age from 112 to 134 months with a mean age of 123 months (10 years 3 months) and a standard deviation of 5.9 months. Participants were selected to participate based on their scores on the Multi-dimensional Anxiety Scale[8] for Children (MASC; March et al., 1997) and the Non-Verbal Matrices (NVM) subtest of the Cognitive Assessment System (CAS; Naglieri & Das, 1997) as collected in phase one. In accordance with the MASC scoring guidelines, participants were divided into low and high anxiety groups that were matched for non-verbal reasoning ability as assessed on the NVM. The total number of sampled pupils with parental consent (n=256) were quartered, in terms of their MASC scores, and the upper and lower quartiles were invited to participate in this study. As above, parental consent was reconfirmed and additional signed consent forms collected. The high anxiety group consisted of 16 pupils, 8 males and 8 females. The mean NVM score of the high anxiety group was 12.64 (SD = 2.61). The low anxiety group consisted of 18 pupils; the gender split consisted of 12 males and 6 females. The mean NVM score of the low anxiety group was 12.60 (SD = 2.55).

The data of two participants was excluded from the analysis. After completion of the assessments it was established that one participant was likely to have a specific learning difficulty (SpLD) and another lacked concentration on the task switching measure[9]. The outcomes for these pupils will be discussed in section

[8] Pupils who participated in the study were non-referred and had no other special education needs as identified by the school SENCO. The MASC was used as a screener given its ability to distinguish between high and low levels of anxiety. Only the self-reported scores were used to designate group classification (high and low anxiety groups). There was no triangulation of the data.

[9] During the task-switching experiment it was noted that one participant did not appear to be concentrating. Upon completion, the task data was analysed and the individual was found to have made more errors than could be expected by chance. A high number of errors can skew the data by circumventing the counterbalancing measures. Another concern is that the data (after group analysis) may not be representational of the desired population. Therefore, the decision was taken to drop the data from the overall analysis.

3.5, ethical considerations. In addition, there were an additional two participants whose results would allow them to move forwards into phase two; however entering phase two was discussed with the parents and their consent was withdrawn as they did not see how the research would benefit their children.

As this project was linked to a number of external pressures, only two groups (pupils with high and those with low scores for anxiety) were included in the research. I was unable to use a third group ('middle range scores') because of these pressures.

3.3. Measures

Potential participants were asked to complete two questionnaires.

3.3.1 Multidimensional Anxiety Scale for Children (MASC) (March, Parker, Sullivan, Stallings & Conners, 1997).

This assessment tool is a 39 item self-report questionnaire that identifies the presence of anxiety disorders in children. Scores are determined by responses indicated on a four point Likert scale (0 – Never true about me, 1 – Rarely true about me, 2 – Sometimes true about me, 3 – Often true about me). It distinguishes between anxiety symptoms and dimensions (physical symptoms, social anxiety, harm avoidance, separation/panic) as well as giving an overall MASC score, Anxiety Disorder Index and Inconsistency scale. Internal consistency scores range from 0.74 to 0.90. Test-retest reliability ranges from 0.34 to 0.93. A reliability coefficient for Cronbach's alpha based on this research population was found to 0.93.

Rationale.

Silverman and Ollendick (2005) completed an overview of evidence based methods and instruments available for use in assessing anxiety in children and adolescents. The authors reported the Multidimensional Anxiety Scale for

Children (MASC; March et al., 1997) as having more supportive evidence and recommended its use as a measure of non-clinical levels of anxiety.

3.3.2 Cognitive Assessment System

Cognitive Assessment System (CAS) (Naglieri & Das, 1997a)

Naglieri and Das (1997a) published their Cognitive Assessment System (CAS) as a tool to assess cognitive functioning for children and adolescents ranging from five to seventeen years of age. Based on a modern theory within the information-processing framework it offers itself as being able to provide psychometric assessment of cognitive processes. Additional, the CAS was developed based on Luria's (1966) model of executive function which fits nicely with Miyake et al's (2000) work.

The simultaneous processing scale (Basic Battery) was administered to the participants in order to investigate how anxiety may affect cognitive performance when heavily taxed. As previously stated, the non-verbal measure will also be used to ensure similar reasoning abilities between the low and high anxiety groups. Some of the task switching literature discusses simultaneous processes as being critical to successful switching (Bryck & Mayr, 2005; Groschke, 2000) and as such was a deciding factor for its inclusion.

Simultaneous Processing

The essence of simultaneous processing (SiP) is that the individual must inter-relate the elements of the stimuli into a perceptual or conceptual whole. Simultaneous processing has strong spatial and logical-grammatical components. Children who are good at simultaneous processing find it easy to understand how pieces of a whole fit together as they are able to hold several pieces of information in their working memory and act on them simultaneously. The subtests used from this section were the NVM and the Verbal-Spatial Relationships (VSP) tests. The average internal reliability is 0.89. A mean Cronbach's alpha of the current sample for simultaneous processing was 0.93.

The SiP assessment was included on the basis that Eysenck, Payne and Deraksham (2005) suggested the HA individuals were less able to complete two concurrent tasks, when both tasks required use of the central executive. Eysenck, Payne and Deraksham's (2005) findings were based on a dual modality task[10], where the participants performed a complex visuo-spatial task while concurrently performing a secondary task to further taxing the central executive. In the task-switching experiment, the participants are required to hold two response sets[11] in their WM (i.e. responding to the body style or leg length and the correct responses for each variable).

Non-Verbal Matrices

The non-verbal matrices (NVM) subtest from the CAS is a thirty-three item multiple-choice assessment. Participants are required to select the most appropriate answer from a selection (5-6) of possible responses. The assessment items consist of a variety of formats including the completion of geometric patterns, reasoning by analogy and spatial visualization, getting increasingly difficult as the participant works their way through the items.

The NVM was used to ensure that any differences found in various measures between the LA and HA groups could be more readily attributed to anxiety. In particular, reading comprehension has been reported to be correlated with non-verbal ability (Bishop & Adams, 1990) and hence the need to control for this possible affect in the data. By doing so, any main differences seen between the groups would be less likely to be attributed to non-verbal ability differences.

Verbal-Spatial Relationships

[10] Dual modality is a term used in cognitive psychology that refers to an experiment where both auditory and visual processes are used. Dual modality procedures are most frequently used in experiments investigating memory and learning.

[11] Response sets refers to the response mappings for the two tasks. As the stimuli are bi-valent, each affords two responses. The participants therefore need to hold two distinct rules in WM (i.e. the correct responses for both the body and leg task.

The Verbal-spatial relations (VSR) subtest from the CAS is a twenty-seven item multiple-choice assessment that requires the participant to make sense of logical and grammatical descriptions of spatial relationships. Participants are read a statement (also printed on the bottom of each page) that corresponds to one of six drawings shown on a page, from which they make their selection. The items involve object and shapes arranged in a specific spatial manner.

The average internal reliability of the measure is 0.89. A mean Cronbach's alpha of the current sample for subtest is 0.87.

3.3.3 Task-Switching – A measure of the Shifting, Inhibiting and Updating components of executive function

3.3.3.1 Introduction to Task Switching

Task switching is a discipline in the field of cognitive psychology that is interested in investigating the mechanisms of executive control (Allport, Styles & Hsie, 1994; Rogers & Monsell, 1995). There are various procedures and experimental paradigms used to measure task set control (Kiesel et al., 2010). The present study will use a task cueing paradigm.

In a task cueing paradigm, participants are presented with an unpredictable sequence of tasks. The order of task switches and repeats are random so that the participant is unable to prepare their response. To indicate to the participant what task they will be completing the presentation of the stimulus is preceded by a cue (see Figure 3). The cue affords the participant an opportunity to 'prepare' their response by recalling their training. Once the stimulus is presented, the participants are required to respond by classifying one of its dimensions[12] according to rules learned in a practice session.

[12] For example in a stroop task, participants are asked to either read the word, or to give the name of the ink used to print the word. Therefore, one dimension of the task is to name the colour of the ink and the other dimension would be the word itself.

3.3.3.2 Concepts and Key Features

The experimental design involves participants being presented with a bivalent[13] stimulus on each trial to which he/she must respond (with a button press on the keyboard mouse pad) following rules[14] that define the task. These 'rules' are referred to by the 'cue' and they indicate to the participant what feature of the stimuli they should respond to[15]. On some trials this rule changes (called a switch trial) and on others it remains the same (called a repeat trial). Comparing performance on repeat trials with performance on switch trials one can measure the 'switch cost'[16] (Rogers & Monsell, 1995). Switch costs are interpreted as a measure of processing demands involved in changing from one task-specific cognitive configuration to another (see Monsell, 2003).

By modifying different variables within a cued switch task, such as the cue-stimulus interval (CSI) one can explore the effect of preparation[17]. Meiran (1996) showed that when the CSI exceeds 500 ms, and when the participant is utilizing this time to 'reconfigure their task set'[18] the executive functions are 're-loading' the motor commands necessary to respond to 'shape' as learned during their preliminary practice and use, the switch cost can be decreased. Another argument put forward is that switch costs can be explained by proactive

[13] Stimuli in a cued task switch paradigm are typically bivalent, meaning that they afford two distinct choices. For example, when presented with a red coloured square, the participant could respond to either the *shape* or *colour* of the stimuli.

[14] The rules are learned during a preliminary training phase where the participants practices, with immediate feedback, which buttons correspond to each particular feature of the stimuli (Left button for square, right button for circle, left button for red, right button for green). As each button will correspond to two features, the learning in conducted in serial fashion (practicing shape responses, then moving on to colours) before they are combined for a true practice of the task switching exercise.

[15] For example, if the stimulus presented were a red square, the participant would press the button that they have learned during the training session that corresponds to the *shape* 'square'.

[16] For example, if the average time for a switch trial is 900 milliseconds (ms) and for a repeat trial it is 500 ms, the switch cost (calculated as switch minus repeat) would be 400 ms.

[17] Preparation is the time between the presentation of the cue, and the presentation of the stimulus. Longer CSIs afford more time to the individual to configure their response set (an act of the executive functions) and results in a decreased response time when compared to trials with shorter CSIs.

[18] A task set is defined as an effective intention to perform a task. A reconfiguration involves the cognitive configuration of ones attention in accordance with the specific demands of a given task.

interference from the previous task set, called task-set inertia[19] (TSI) (Allport et al., 1994). TSI is concerned with the response-cue interval (RCI) which is the time between the subject's response and the cue on the next trial.

Various effects can be confounded with results in task switching experiments. One such issue arises when a participant completes a switch task but when the stimulus-response (S-R) rule is the same as was on the previous task. This is known as the congruency effect and often results in slower and less accurate responding than on trials where the S-R mapping changes (known as incongruent trials). Given the shared S-R mapping, a correct response is either indicative of a successful switch or the participant's failure to apply the learned rules for the newly presented task. In other words, a participant will be less likely to make an error even if they do not 'prepare' for the new task. Meiran, Kessler & Adi-Japha (2008) tested the hypothesis that congruency effects reflect activated 'over learned' response maps in the procedural memory. They concluded that the maintenance of these response sets might have a linguistic or verbal basis.

Another such issue is centred on the affects of the cue being given before the stimulus and how this can make the interpretation of results difficult. Logan and Bundesen (2003, 2004) argued in two papers that switch costs are more likely to reflect processes involved in interpreting the cue than other executive processes, such as those required to 'switch'. In order to investigate what effect the cue has on switching, Logan and Schneider (2006) used transparent (readily identifiable with the stimuli) and non-transparent (less strongly paired) cues. Similar to Meiran et al. (2008), Logan and Schneider (2006) suggested that participants used words, as mediators, paired with the target to form compound retrieval cues in order to retrieve the S-R mapping from memory. Grange and Houghton (2010) went on to investigate this hypothesis and defined cue-transparency as the degree to which the cue exogenously provides or directly stimulates the relevant WM representations required to perform the task. They went on to stipulate that non-transparent cues do not provide the

[19] This is when previously used rules or learning affects an individual's next response.

relevant WM representation, and the therefore participants must activate the S-R representation endogenously (i.e. a top-down process). However, Logan and Schneider's (2006) commented that with sufficient practice the non-transparent cue also becomes automated and can result in similar RT's for both transparent and non-transparent cues.

Rationale

A defining feature of human behaviour is our ability to act flexibly in response to our ever-changing environment. Our actions are guided by both endogenous and exogenous[20] factors. Furthermore, each object or situation affords multiple responses and behaviours, selected through the interaction of cognitive control processes, previous learning and experiences. In some instances these decisions are automatic (i.e. stroop effect) while at other times the individual is in control (i.e. standing still instead of running away from a bear). It is the ability to control behaviour flexibly by responding automatically (reactive) in one situation, while being able to suppress it and act more proactively in another that is the defining feature of executive control.

Executive control is a term used to describe the many processes that afford goal-directed action (Friedman, Miyake, Young, DeFries, Corley & Hewitt, 2008). It is considered to be the deployment of attention, albeit devoid of a definitive mark, depicting where one process ends and another begins (Friedman et al., 2008). It has been proposed that executive control comprises three main functions (Miyake, Friedman, Emerson, Witzki & How-Erter, 2000). The first function is inhibiting inappropriate responses or interference from irrelevant information. The second function is the ability to direct attention to task-relevant information and updating both goal directed and task dependant behaviour. The third function is the maintenance of information in declarative and procedural memory for storage and retrieval. The focus of attention and the cognitive resources that maintain our readiness and commitment to a

[20] Exogenous selection occurs as a by-product of our nervous system. Humans are 'pre-wired' to respond preferentially so that there is an innate continuum of salience, with some stimuli and responses more likely to receive exogenous selection than others (Castro, 2009).

particular response is called a ‘task-set’. It is thought that the task-set represents the information dominating the procedural WM (See Figure 2). As our attention shifts from one interest or task to another, so does our preparedness to act on it. This shift from being prepared to act on one goal to another is referred to, in the cognitive literature, as a task-switch.

As such, task-switching is regarded as a gold standard measure of executive function and attentional control, especially concerning the shift function (Rogers & Monsell, 1995; Monsell, 2003; Derakshan & Eysenck, 2009). Additionally, there have been no published research investigating switching and anxiety despite several recommendations being made by other published authors. Furthermore, the experiment was programmed and designed to use bi-valent stimuli thereby it could be considered as dual-task, another area that is low in publications exploring anxiety and performance.

3.3.3.3 Apparatus for task-switching measure.

The experiment was generated and run using E-Prime software (Psychology Software Tools Inc, Pittsburgh, P.A.). Assistance was given by two staff members of the Psychology Department (University of Exeter) for the programming of the software script that enabled the task switching measures to be run in E-prime and counterbalanced. Once this was written and loaded, the software recorded the participants’ reaction times in milliseconds. The program was presented on identical Dell laptops using the two keys on the centrally located mouse pad to register participant’s manual responses. Participants sat approximately 50cm away from the laptops.

3.3.3.4 Stimuli for task switching.

The stimuli were schematic line drawings of imaginary animals (see Figure 2 for a sample, see Appendix I for the complete list). The set of animal stimuli was composed of various combinations of body pattern (spots or stripes) and leg lengths (long or short) (see Appendix F). Displayed, the stimuli were

approximately 6-8 centimetres (cm) tall and 8-11.5 cm across, presented centrally on a white background.

Figure 2. Schematic line drawings of imaginary animals**.**

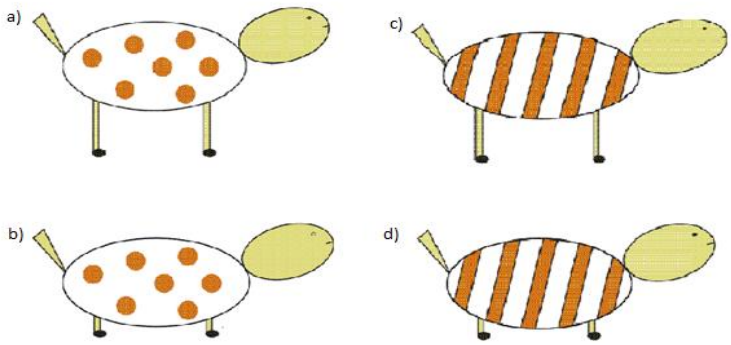


Figure 2 shows the possible combinations of relevant features of the stimuli used in the task switching experiment. Diagram a) shows the dots with long legs stimuli type, b) the dots with short legs, c) the stripe with long legs and finally d) stripes with short legs. The stimuli also included examples with downward pointing tails and some with smaller heads as an additional random occurrence that did not require attending to. As with all of the different stimuli, their presentation was counterbalanced both within and between individuals.

The audio cues used in the experiment were recorded (16bit mono, sample rate 44KHz) by a native British speaker with no discernible regional accent. The recordings were cut and formatted, using Audacity software (trademark copyright Dominic Mazzoni), to a length of 400milliseconds (ms) each. Audio cue playback was bi-aurally via ‘ear bud’ headphones.

3.3.3.5 Conditions for task switching

The experimental conditions had manipulations of the following factors:

CSI – 200ms (short) and 1500 ms (long)
Switch (switch and repeat)
Cue type (transparent, non-transparent)

Response Congruency (congruent, incongruent)

The dependent variables were reaction time (RT), error rates (ER)[21].

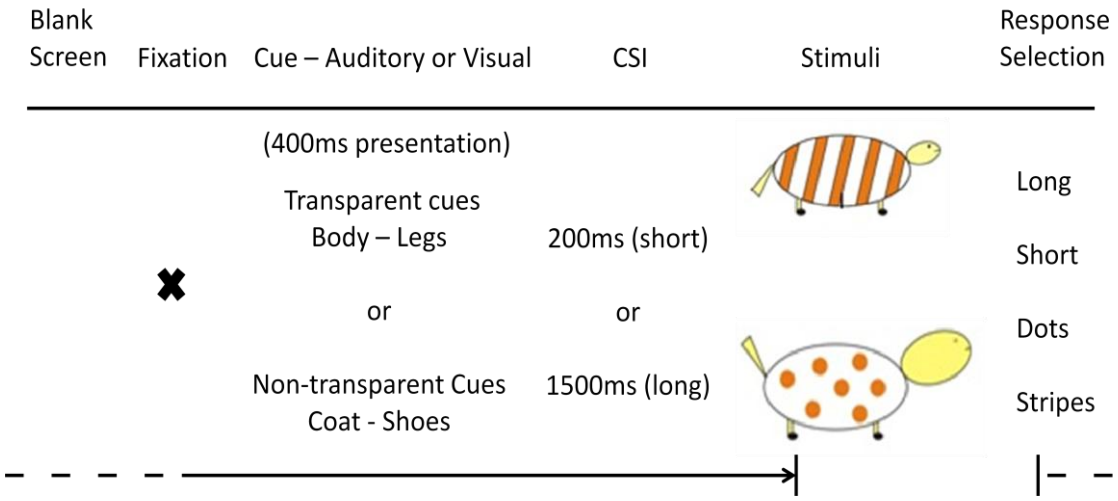
3.3.3.6 Experimental Design

Task switching experiments involve comparing performance between switch and repeat trails. This particular experiment was intended to assess executive function differences between high and low anxiety groups and to test predictions as made by the ACT model of executive function. Though the task switched unpredictably, the experiment was designed so that the task repeat was twice more likely than a switch. This has been shown to discourage participants from preparing for a switch even before they are presented with a cue (Monsell & Mizon, 2006). The stimuli could also be congruent or incongruent to the previous trial. Congruency effects reflect faster responses to stimuli for which the previous task rules give rise to the same correct response on the current trial and were counterbalanced between and within participants.

The two CSI's (short/long) were counterbalanced within participants. Furthermore, a constant response to stimulus interval (RSI) of 2300 ms was used in both CSI conditions to allow for passive dissipation of the task set between trials (Meiran, Chorev, & Sapir, 2000). The differences in time were measured by the participants pressing on the mouse pad; this response then determined the duration for which a blank screen would be displayed before the start of a new trials as computed by the programming of the experiment. An example of a trial is shown below in figure 3.

[21] The dependent measures for Paper Two also included the standardized scores on the CAS, BAS and PhAB assessments as well as the state anxiety measure.

Figure 3. Diagrammatic representation of the task-switching sequence



The above diagram represents the task switching procedure. The dotted line running along the bottom represents where there are variations in timing in order to maintain a constant total trial time.

3.4 Procedure

3.4.1 Data Collection Phase One.

The data collection, as a whole (for phases one and two), took place over two sessions. During the initial session (phase one), participants first completed the MASC questionnaire (See Appendix A1). Though the MASC was designed as a self-report questionnaire, it was intended for a North American market and, as such, the wordings of some of the questions were not thought to be appropriate for a UK population (See Appendix B for alterations). Therefore, with the children following along, the researcher read the instructions and questions aloud to the pupils who then filled in their answers on their own record form. This also afforded the opportunity to answer any questions that the children may have had about a particular question. When completed, the questionnaires were collected and the recording forms for the NVM (See Appendix C) were handed out.

The NVM assessment was conducted as per the standardized instructions in the CAS booklet with two exceptions. Firstly, the discontinue rule was not followed; this decision was taken due to the difficulty of administering the discontinue rule when conducting the assessment as a group test. Secondly, the stimuli booklet was presented via an overhead projector so that all pupils could complete the assessment simultaneously. Upon completion of the NVM, phase one was finished and the data was taken away to be analysed which would allow for the creation of the two experimental groups.

3.4.2 Phase One Data Prep and Analysis

The data collected from the MASC and NVM measures were transcribed into an Excel spreadsheet. Scores for the MASC were calculated so that each individual could be rated in terms of a total anxiety score. This data was then rank ordered so that the lower and upper quartiles could be established. These MASC scores were then paired with the standardized scores from the NVM measure. This enabled potential participants for phase two to be matched for non-verbal reasoning abilities. A total of thirty-six participants from phase one were eligible to proceed to phase two. Additionally, eight pupils who were not eligible for the research based on their MASC scores were asked to pilot the task-switching measures to determine if there were any unforeseen programming faults[22]. Before phase two started the data was analysed and was compared with data typically gathered in undergraduate populations. This was a crucial step as it was uncertain how children would perform given that there is only one other published account of children being used in the task-switching paradigm literature. Furthermore, there are no account of anxiety being a variable in the task switching paradigm especially not with children and young people as participants. The data was a good fit and it was decided that the task switching in phase two would continue.

[22] The pilot study fulfilled two purposes. The first being to ensure that the programming was correct and the children were able to complete the tasks. The second was to ensure that there were no significance affects in children that had not been previously encountered in adults. The results from the pilot study were positive and the research started.

3.4.3 Data Collection Phase Two.

Between phase one ending and phase two starting two parents withdrew their consent. Their children's data was destroyed. Phase two involved all of the remaining individual assessments. This took place between one day and four weeks following the initial phase one assessments[23].

Pupils who met the criteria to move on to phase two were asked if they would be interested in completing further assessments. Pupils who agreed to take part in the study were led from their classroom to an empty classroom or school office where four laptops (required to complete the task switching exercises) were set up in opposite corners. The participants were spaced apart from each other and facing opposite directions so that they could not see their classmates. This was done to minimize distraction and maximize the potential for full concentration on the assessment.

After introducing everyone and briefing the participants, they were given a participant number and told to keep it in their pocket for the entire session, as this would be their special identification number[24]. The participants were told that if they had any questions at any time that they were free to ask, that they were free to leave and go back to their classrooms at any time and that between the different measures that there would be short breaks.

Once the initial formalities were taken care of and the participants invited to choose a laptop to sit at before they were read instruction about the upcoming computer-based task (see Appendix E). During the phase two visits, pupils completed the computerized task switching experiment (See Appendix F and E for instructions and stimuli) and the CAS Verbal Spatial Relationship subtest (See Appendix D). The instructions, presented verbally and visually on the laptop screens instructed the participants to place both index fingers on the right

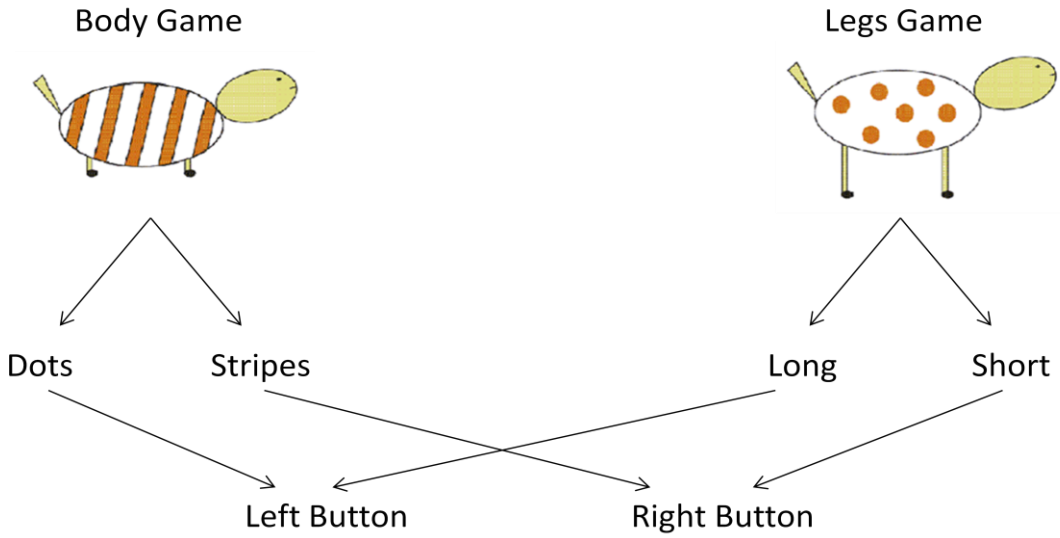
[23] The variability in time scales was due to the time needed to complete the individual tests required for both phases. As a maximum of eight pupils could be assessed in one day, some school were revisited on several occasions.

[24] Participant numbers were used on all assessment forms so that once anonamised, it would be possible to match all of the various assessments to one individual.

and left mouse buttons respectively. Participants were shown how to push the mouse button to respond instead of tapping the button[25]. They were asked to respond as quickly and as accurately as possible.

Participants first completed training blocks[26] (consisting of twenty-four discrete trials) consisting of only one task (one block for the body game, then another block for the legs) in order to familiarize themselves with the tasks. In the body game, participants learned the response mappings[27] for dots and stripes. In the second block, the participants played the legs game, learning the response mappings for short and long legs (see Figure 4).

Figure 4. Stimulus-response mappings.



The final training contained four blocks of twelve trials for which participants were asked to wear the supplied headphones. They were informed that a message either on the screen or through the headphones would tell them which game to play. If the participants heard the transparent cue legs or the non-

[25] Tapping the button would mean that the participant would first lift their finger before putting it back down and pressing the button. This is likely to have increased the RT's and hence needed to be eliminated.

[26] The term 'block' refers to a defined number of experimental trials that require completion before the participant can have a short break and, when ready, can start another 'block' by pressing a mouse button. On average each block, in this part of the study, took 4 minutes to complete.

[27] A response map is a phrase used to signify the S-R mapping acquisition. Through repetition, this response can become more automatic.

transparent cue shoes they were to play the previously learned 'legs' game. If they heard the transparent cue body or the non-transparent cue coat, they were to play the body game. These four blocks mixed both the body and leg games (task switching). The cues alternated on each trial (switch and repeat) to control for cue-switching effects (Logan & Bundensen, 2003; Logan & Bundensen, 2004). During the practice sessions, feedback was provided on the screen after each trial. Following a response being made, the messages 'well done' and 'woops, wrong button' were flashed on the screen for three seconds. In the final four blocks of twelve trials, participants only received the feedback if they made a mistake.

Upon completion of the practice session and a short break, the participants each completed four blocks of forty-eight trials of task switching. The whole computer assessment last approximately 25 minutes. Participants were thanked for their participation and given a 2-3 minutes break. Once completed, the participants completed the remaining assessments.

Completions of all assessments were counter balanced for gender, high and low anxiety groups, and time (morning or afternoon) of assessment. This was facilitated by the support of two assistants[28] to help organising the children and with some of the assessment work. The standardised procedures, as set out in the tests manuals, were followed for each assessment. For all measures, the pupils were asked to only look at their own record forms, as it was important that they not only answered for themselves, but that their answers reflected their own thought and feelings, and not those of their peers.

Upon the conclusion of the data collection, the record forms were checked for errors, missing data, scored and then the results were analysed before being

[28] In order to complete the assessments in a suitable timescale, three assistants were recruited to assist in the data collection. Both were enrolled in the third year undergraduate psychology course at the University of Exeter and had showed an interest in working with children. The assistants were given three days of instruction and practice in delivering their respective assessment. This was to ensure that each participant would receive the same treatment. Each assistant had a full CRB disclosure.

anonamised. This was done so that where additional needs were identified, I would be able to support the pupil and school in whatever capacity that was required. This will be further discussed in section 3.5 under the heading Ethical Considerations.

3.4.4 Data Preparation

Creation of the high and low anxiety groups and scoring of the NVM was discussed in section 3.4.2 and was completed preceding the statistical analysis. This data was copied into SPSS and the analysed with the rest of the data where mentioned.

For the task switching data, errors, trials following errors and the first trial of each block (as they were neither switch nor repeat) were excluded from the analyses. Furthermore, RT's over 4 seconds or less than 200ms (outliers) were also excluded. A repeated measures ANOVA with the factors Trial type (switch/repeat), CSI (long/short), Congruency (congruent/incongruent) and Cue type (transparent/non-transparent) was carried out on median RT's to look for group differences. Where a significant interaction was found, a further one-way ANOVA was performed to determine the means of the medians in order to establish the direction of the effect. As medians are less sensitive to extremely slow and fast responses they are acceptable to use for reporting RTs (Howell, 2002). The use of medians is also becoming the convention in the developmental literature (Cepeda, Kramer & Gonzalez de Sather, 2001). ANOVAs with the above-mentioned factors were also performed on error rates.

For all of CAS measures mean standardized scores were used for data analysis and comparison. Standardization removes bias and variation related differences due to age. This allowed for more reliable comparisons between groups and individuals.

3.5 Ethical Considerations

Initial verbal consent for the research was obtained from the Principal Educational Psychologist (PEP) from the DCC Learning and Development Partnership, the selected school's head teachers, SENCOs and classroom teachers from the school involved. Ethical approval for the research as a whole was obtained via The University of Exeter Ethics committee (See Appendix G for certificate of Approval).

Consent was obtained from parents of the children via letters/permission slips being sent home before gaining the verbal consent from the children themselves. Parents and children were informed that they had the right to withdraw from the research at any stage before, during or after the assessments. Parents and children were offered the opportunity to meet and discuss any questions that they may have with researcher, before, during, or after the data collection. All participating parties were advised that the data would be anonamised shortly after collection and that it would be kept secure with any identifiable information destroyed. A copy of the blank consent form can be found in Appendix H[29].

Where parents had declined consent for their children to be included, and/or where the child did not want to participate in the research, they were invited to leave the classroom to take part in other activities in their school, for the duration of the phase one assessments, in sessions being led by a teacher.

Participating school staff members were fully briefed concerning the nature of the research and were informed that they would not be given the raw research data. Schools were informed that should an assessment highlight an area in need of further development for a particular child, that strategies would be discussed with the Special Educational Needs Coordinator (SENCo) in order to support the child. It was made clear that this time would not be coming from

[29] As the write-up of the thesis progressed some of the measures were dropped from analysis. In particular, the focus on the correlation with reading ability was omitted.

their usually EP time and that this any support would be in-addition to their usual subscription.

During the first phase of the data collection the purpose for the research was explained to those with parental consent as being that we were aware that children have all sorts of thoughts running through their heads at various times. We were also aware that some children might have worrying thoughts before tests, after being asked to read in front of the class, or sometimes just in general. It was also said that some children never experience or have these thoughts and that both were equally normal. It was explained that for the children who have these kinds of thoughts running through their head that in some instances their ability to perform at their best could be effected, although this might not always be the case. The children were told that the fact that we were unsure what the effect of all of these thoughts might be was the reason for us doing the research as we wanted to be able to better explain what might be going on. The types of assessments that the children would be doing were described and they were asked if they had any questions. Children were informed that should they wish to participate that they should indicate by raising their hands and that it really was their decisions and to not be influenced by their friends around them. Similarly, it was then asked that those who did not wish to participate could meet their classroom assistant at the back of the room who would take them out of the classroom for a short while to go to the school library and look through some books. Those who stayed completed the assessment as indicated in section 3.4.1 followed by a question and answer period so that the children could ask any questions that they wanted to about the mornings exercises.

During the second phase of data collection the children's informed consent was conducted in small groups at each school, including the selected children and their teacher(s). It was explained that everyone had made a good effort during the first session and that some of them were now being invited to take part in phase two of the research because, unfortunately, we did not have the time to invite everyone and we appreciated the thought and care that they took coming up with their own answers when completing the exercises in the first sessions.

The purpose for the research was again discussed. It was again explained that we were asking for some of their time and help but that they were able to say no if they would rather just go back to their classroom. In total, two children said that they did not want to take part. The first offered an explanation that they did not want to miss their Physical Education class and the other did not intimate why.

During the data collection and analysis it was noticed that four children would benefit from additional support. The first child, whose data was removed from the study, underwent further assessment during a follow up visit. It was determined through consultation and assessment that this child would qualify for a diagnosis of a SpLD. Arrangements were made so that I could follow up with this child and family before care was taken over by the patch EP. For two other children it was determined that there was a need for further development for their WM skills. Strategies were discussed with school and parents and plans were put into place to support these children. One other child was identified via the research as potentially having additional needs that may be beyond the scope of EP practice. Notes taken during the task switching procedure resulted in a pupil consultation with their teacher and SENCO before departing the school after the visit. The child was considered to be having significant attentional difficulties and though consultation with parents and school staff it was decided that the best course of action would be for a referral to a paediatrician. It was agreed that I would undertake additional work in order to support the child and school. This data was removed from the research results. All feedback to schools and other invested parties were done in line with EP practice. This involved consultation, some assessment and coaching work. Where appropriate additional visits were made as planned. The children identified as having additional needs were flagged to the patch EPs after parental and school permission had been given. This permission was obtained through the use of our service referral and planning forms.

Chapter Four
Results

4.1 Descriptive Statistics for Anxiety and Task Switching Measures

Table 1 shows the descriptive statistics for the self report anxiety measures. Scores on the MASC can range from 0-112 for females and 0-104 for males. A chi square analysis was used to compare the groups' differences in categorical variables. No significant difference was observed for gender and anxiety, $x^2(1)= 0.427$, $p=0.513$ n.s.

Table 1. Total participants per condition with means and standard deviations.

Anxiety	Gender	n=	Mean	SD
Low	Female	6	27.12	5.31
	Male	12	22.18	4.07
High	Female	8	85.00	1.63
	Male	8	74.75	7.34

Table 2 shows the median reaction times for all conditions in relation to CSI. As expected RTs increased when there was less preparation time as seen in the short CSI vs long CSI comparison. There is a marked switch cost for all conditions indicating that participants used available time in the long CSI to prepare their response sets.

Table 2. Median reaction times (ms) for all conditions by CSI.

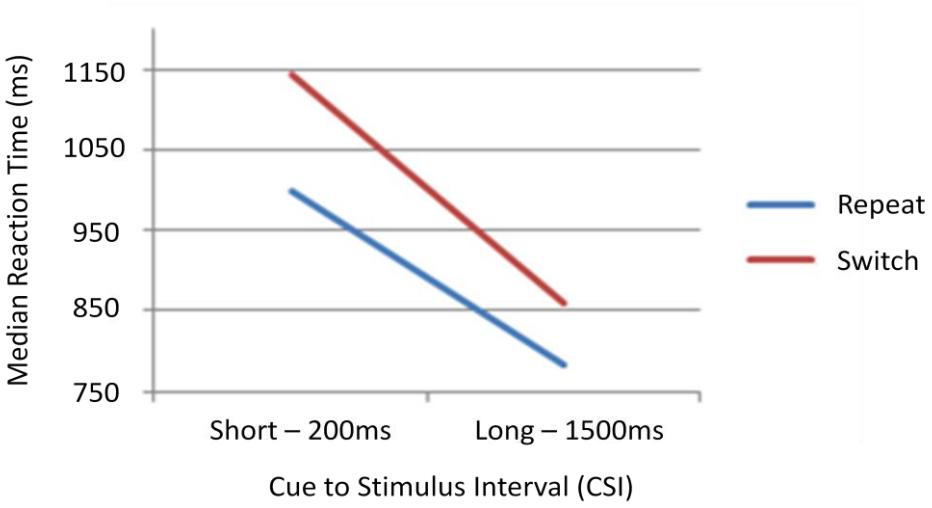
CSI	Short - 200 ms			
Cue Type	Transparent		Non-Transparent	
Congruency	Congruent	Incongruent	Congruent	Incongruent
Switch	1121.00	1113.02	1211.53	1129.74
Repeat	934.15	1004.28	990.82	1057.10
Switch Cost	186.85	108.74	220.71	72.64

CSI	Long – 1500 ms			
Cue Type	Transparent		Non-Transparent	
Congruency	Congruent	Incongruent	Congruent	Incongruent
Switch	823.65	861.40	847.65	903.00
Repeat	740.64	821.19	768.00	798.01
Switch Cost	83.01	40.21	79.65	104.99

4.2 Median Reaction Time Analysis

A significant effect of the factor CSI was found, $F(1,32)=102.793$, $p=<.001$, with a decrease in RTs from the short CSI (1071.2ms) to the long CSI (820.44ms). The effect of Cue Type (CT) was also significant, $F(1,32)=57.017$, $p=.028$. RTs in the transparent cue were 34.8ms shorter than the non-transparent cue. A main effect of Trial Type was significant, $F(1,32)=57.017$, $p<.001$. Repeat trials were on average 111.1ms faster than switch trials. Congruency and Trial Type interaction was also significant, $F(1,32)=4.406$, $p=.044$. Congruent trials had a switch cost of 140.57ms whereas the incongruent trials showed a decrease to 81.64ms.

Figure 5: Median RTs (ms) for switch-repeat in both short and long CSIs.



The figure above shows the reduction in switch cost as the distance (which equals time) between the red and blue lines when compared between the short and long CSIs.

Though not statistically significant, an interaction between CSI and Trial Type was found, $F(1,33)=3.583$, $p=.067$. Switch costs were calculated as 145.23ms in the short CSI, decreasing to 76.97ms in the long CSI. This RISC effect implies that participants were preparing for the task once given a cue, despite the interaction being only marginally significant. In this regard the data collected matches that of previous task switching experiments using older participants and as such enables the comparison of this data to that from other task switching experiments.

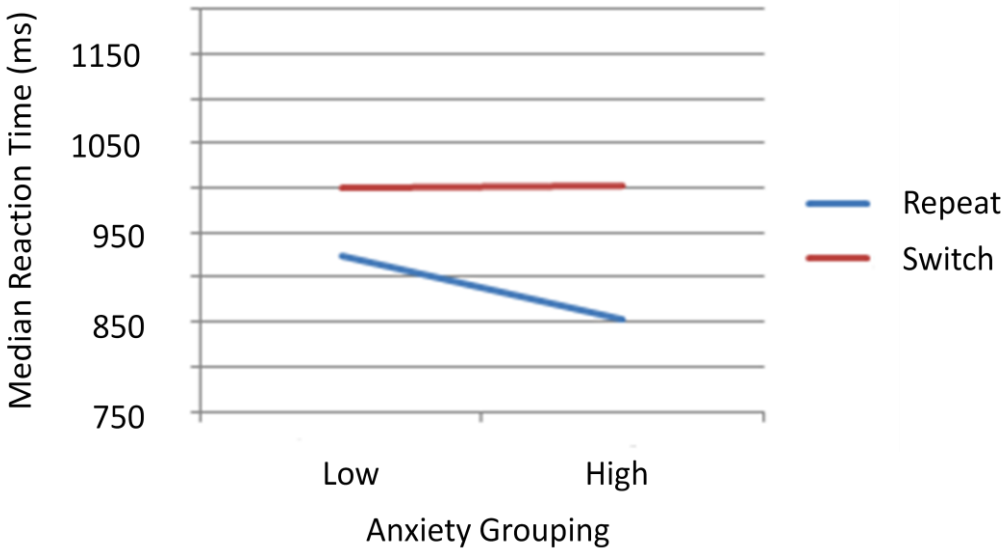
4.3 Test of Hypothesis

4.3.1 Hypothesis 1- ACT Main effect and Shifting.

It was predicted that the high anxiety group would demonstrate a larger increase in response times on switch trails. This served as a test of the decrease in cognitive performance caused by anxiety.

A repeated measures ANOVA was performed using the factors Congruency (2), CSI(2), Transparency(2) and Trial Type(2) with the between subject factor of high versus low anxiety groups. An interaction between trial type (switch versus repeat) and anxiety was found (figure 6), $F(1,32)=7.38$, $p=.011$. Further analysis of the means of the medians was performed in order to establish the direction of the effect. This indicated that the LA group had a switch cost of 76.6ms, whereas the HA group had a switch cost of 149.9ms. The two groups performed similarly on switch trials but the HA group were significantly quicker (74.2ms) for repeat trials (Figure 6). Although the HA group were quicker to respond than the LA group on repeat trials they did not maintain this advantage in the more difficult condition. Support was found for hypothesis 1.

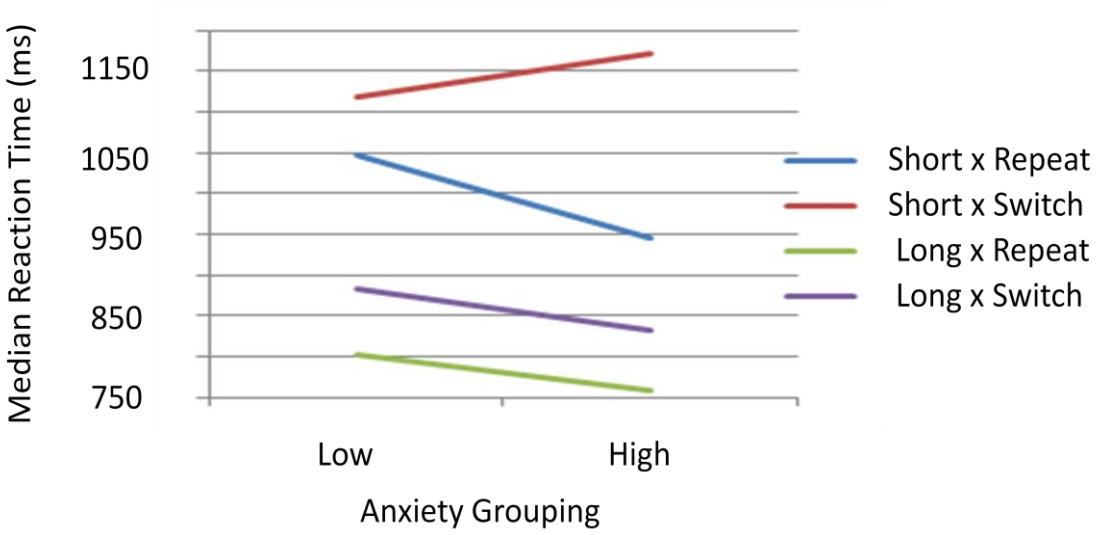
Figure 6: Switch cost difference between HA and LA groups.



Further analyses were conducted to determine the impact of CSI on performance. A repeated measures ANOVA using the factors CSI, Trial Type with anxiety as the between subject factor was conducted. A significant interaction of these factors was found $F(1,32)=5.66$,$p=0.024$. Analysis of the means showed the HA group was quicker than their LA counterparts in all conditions, except when switching in short CSI trials (figure 7). LA participants had a RISC from preparation of just 7.434ms, whereas HA participants had a RISC of 153.41ms, showing that anxious participants prepared more effectively

than non-anxious participants did on repeat trials although they were slower when under pressure.

Figure 7. Median RT (ms) for CSI, trial type, and anxiety interaction.



4.3.2 Hypothesis 2 - Inhibition

ACT predicts that anxiety impairs the inhibition function. The main effect of congruency being mediated by anxiety was not significant F(1,32)=0.615, p=0.439 n.s. The same analysis looking at anxiety, congruency and error rates was also not significant F(1,32)=1.182, p=0.285.n.s. ACT makes the prediction that performance effectiveness is increasingly impaired as task difficulty increases. It was originally postulated that looking for a congruency effect in a more challenging task may prove successful. A repeated measures ANOVA with the factors congruency (2) x trial type (2) x CSI (2) x anxiety (2) was run. Although improved over the initial analysis, the present condition also failed to meet a level of significance F(1,32)=3.71, p=0.063 n.s. This same lack of effect was shown in the error rates F(1,32)=0.039, p=0.845 n.s. Despite not showing statistical significance inspection of the medians was performed in order to look for the direction of the effect (Table 4 and Figure3).

Table 3 shows the mean reaction times for the medians in three conditions across the high and low anxiety groups for both CSI, Trial Type and Congruency. On some trial conditions the incongruent trials showed an

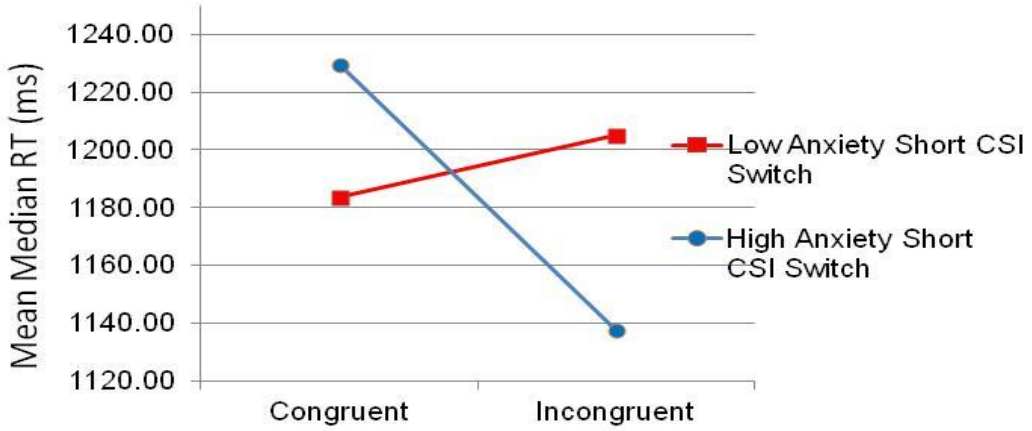
increase in RTs although when the difficulty was at its highest this was not the case. The cost column indicates the decrease in efficiency in found between congruent and incongruent trails as recorded in ms. Note that a negative sign actually indicates a decrease in time taken to respond and as such provides data to confirm the null hypothesis.

Table 3. Mean median RTs across Anxiety, CSI and Trial type factors across Congruency effect.

Anxiety	CSI	Trial Type			
			Congruent	Incongruent	Cost
Low	Short	Repeat	1159.37	1170.2	10.83
		Switch	1183.74	1205.07	21.33
	Long	Repeat	882	963.87	81.87
		Switch	959.3	951.3	-8
High	Short	Repeat	1119.9	1120.6	0.7
		Switch	1229.52	1137.82	-91.7
	Long	Repeat	866.27	890.71	24.44
		Switch	858.11	991.14	133.03

Overall the switch cost associated for the congruency effect gave a mean of 26.50ms (SD=38.85) in the low anxiety group and a mean of 16.62ms (SD=92.37) for the high anxiety group. For the incongruent trail the high anxiety group outperformed the low anxiety group by 67.25ms. Given the surprising nature of the result a graph was plotted to illustrate the finding. Figure 8 shows the main data trend captured in the above table. The high anxiety group showed a 91.70ms advantage over the low anxiety group in the short CSI, Switch, Incongruent factor trials.

Figure 8. Mean median RTs (ms) from the 4 way interaction between Congruency and Anxiety for the Short CSI Switch Trials.



On average, anxiety did not impair the inhibition function for this data set although the large SDs for the mean switch cost differences indicates that the data should be interpreted with caution.

4.3.3 Hypothesis 3 – Efficiency versus Effectiveness

Anxiety was expected to show a greater impact on reaction times then error rates.

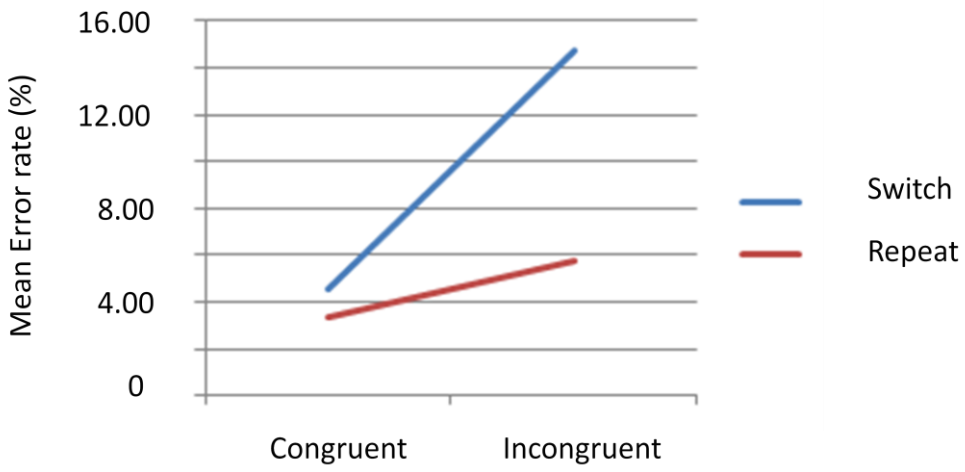
Table 4 shows the descriptive statistics for the error rates found in the task switching measures. There were a greater number of errors for the incongruent trails. This is typically seen in task switching experiments and is not thought to relate to task-set activation in working memory but instead from a direct stimulus-response association (Kiesel, Wendt & Peters, 2007).

Table 4. Means of the main-effects for median RT's and error rate (%).

Main – Effect		Median RT (ms)	Error Rate (%)
Congruency	Congruent	930.67	3.96
	Incongruent	960.97	10.28
CSI	Short (200ms)	1071.2	7.95
	Long (1500ms)	820.44	6.28
Cue-Type	Transparent	928.42	7.51
	Non-transparent	963.22	6.72
Trial Type	Switch	1001.37	9.66
	Repeat	890.27	4.55

Due to the sizeable increase in error rate for incongruent trials the medians were analysed. Error rate analysis of the data disregarding anxiety showed that the factor congruency was significant F(1,33)=31.552, p=<.001, with congruent trials also having a lower error rate (4%) compared to incongruent trials (10.3%). A significant interaction was also found between congruency and trial type, F(1,32)=19.762, p=<.001 (Figure 7). Incongruent trials (figure 9) showed an error cost of 8.96 % whereas congruent trials showed a 1.21% error cost. The error rate cost of a task switch was reliable at F(1,33)=57.751, p=<.001. This reduced from 9.7% on switches to 4.6% on repeats.

Figure 9: Mean error rate for the Congruency factor.



A 2x2x2 repeated measures ANOVA was performed on the error with Congruency and Trial Type as within subject conditions and Anxiety as a between group condition. As stated in section 4.2 anxiety was shown to have a significant interaction with Congruency and Trial type $F(1,32)=4.406$, $p=.044$. The error rate was not shown to have a significant effect on this interaction $F(1,32)=0.788$,$p=0.381$ n.s. There were no other significant effects found for error scores when task switching was compared between anxiety groups. There is evidence to support the third hypothesis that anxiety has a greater effect on efficiency than on effectiveness.

4.3.4 Hypothesis 4 – Updating

Anxiety was expected to show a modest effect for the updating function. An ANOVA was performed between the factors CAS Simultaneous Processing (as a measure of updating ability and grouped into high and low groups), Anxiety(grouped into high and low scores), Congruency and Switch. The result of the analysis was not statistically significant $F(1,28)=3.230$, $p=0.083$ n.s.

In order to see the direction of the effect, the mean difference in RTs for high and low simultaneous processing abilities between the high and low anxiety groups was calculated. The means highlighted less variation between high and low anxiety groups for the high ability simultaneous processors ($M=8.27$) compared to the low ability simultaneous processors ($M=86.61$). It this sense it could be argued that simultaneous processing appeared to mediate the effect of anxiety although this result did not meet statistical significance.

Chapter Five

Discussion

5.1 Opening

This thesis investigated the relationship between non-clinical levels of state anxiety and cognitive performance in year five and six pupil with no pre-existing special educational needs. The initial pilot study aimed to investigate if children aged nine to eleven showed a RISC effect. This was to enable the comparison between this research and previous task switching work.

Data analysis supported the hypothesis suggesting that similar to adults children used the time in the longer CSI to prepare for an upcoming response. This identifies that children are able to reconfigure and control at least four cognitive functions. These include shifting attention between at least two stimuli characteristics, retrieving goal states and action rules, recalling S-R mappings and inhibiting responses from the previous task set. This differs from the findings of Cepeda et al. (2001) who reported no RISC effect in children. However, Cepeda et al. (2001) had a methodological issue that may have attributed to their inability to demonstrate a robust RISC effect. The manipulation of the experimental design was successful in achieving its aims and was able to rectify the errors in two other task-switching experiments involving children; by adding two cues per task and by decreasing the CSI while maintaining a constant RCI.

The present undertaking also demonstrated a congruency effect. Congruency effects are well established in adults (Monsell, Yeung & Azuma, 2000) and are thought to reflect task-set conflict, typically being shown as quicker RTs for congruent trials. ACT predicted that responses for congruent trials would be quicker than incongruent trials due to activation from the most recent trial. The literature suggests that RTs for congruent trials are faster (Meiran, 1996) with larger switch costs found on incongruent trials (Nieuwenhuis & Monsell, 2002). Results from this research, however, run opposite to more typical findings as a

larger switch cost was present in the congruent trials. This was chiefly due to quick RTs for the incongruent trials. However, the error rates hint at an accuracy trade-off, with incongruent trials showing a much higher error switch cost than congruent trials. Therefore, it may be that the larger switch cost in congruent trials reflected 'surprise' or an internal response conflict due to the same stimulus response mappings being 'prepared' for different tasks. Alternatively, it may be that optimal performance on the incongruent trials reflected the participant's motivation to do well and because of this there was no room for improvement.

Additionally several of the assumptions made by ACT were empirically tested in order to gain further insight into the causal effects of anxiety. The results indicated that overall there was a negative association between state anxiety and performance. However, the data also revealed that anxiety has a marked ability to improve performance on a range of tasks and is in line with the Yerkes & Dodson (1908) model of performance. The discussion will tackle each of the cognitive functions are proposed by Miyake et al. (2000) discretely before moving on to more general outcomes and limitations. The knowledge gained by this research will then be placed within the context of EP and implications for practice will be discussed.

5.2 Shifting

The data indicated a significant interaction between anxiety grouping (high versus low) and trial type (switch versus repeat). The high anxiety group showed a greater cost indicated by increased RTs when comparing the mean RT for repeat and switch trials. The difference seen between the two trial types were significantly larger for the high anxiety group. However a look at the data indicated that the HA did not perform significantly worse in the more challenging condition (switch trials) but rather that they outperformed the LA group in the repeat trials.

Mikyake et al. (2000) first associated the shifting function with task switching and the data does suggest that HA impairs performance on more challenging

tasks when attention must shift within and between tasks. The data positions itself rather uniquely in the literature as it is believed that it is the first to attribute this difference not solely to worsened or impaired performance for the HA group but that their performance on the easier task was shown to improve. ACT predicts that when the task complexity is high the negative effects of anxiety should impair processing efficiency more than when the task is easy. While this statement is support by the data what could also be argued is that this thesis suggests that in some conditions, that anxiety might manifest itself as a shift in the baseline. To reframe the findings, the data suggests that when task difficulty is matched with a similar level of skill, those with higher levels of anxiety can actually improve performance and as such is in line with other research reporting the Yerkes-Dodson effect (1908). Overall there was a net decrease in performance although perhaps not solely due to anxiety impairing performance in more difficult conditions but rather improving it in others. It should be noted however that this may not be generalizable to all conditions but that in this case, the data has shown the prediction of ACT can be met without requiring an overall worsening of performance. In this regard, it could be argued that anxiety increased 'preparedness' for the task as shown by the RTs for the repeat trials. The HA group seemed more motivated to do well and try their very best. This also supports the literature that suggests that a HA group can perform as well as LA group albeit with the requirement of increase effort and attentional resources.

An alternative explanation is that previous research in the task switching area has focused on mainly undergraduates and older participants. The incentive for many undergraduates to participate in research is to fulfil first year course requirements or for financial gain (albeit modest). For children the incentive and desire may be to perform well and to try their best as it is novel and unique for them. In this sense what might be the most influential factor is intrinsic motivation. Intrinsic motivation has shown to be paramount in terms of successful outcomes in both education and vocational settings (Sansone & Harackewitz, 2000). Csikszentmihalyi attributes motivation and flow to a range of positive outcomes and his theory of flow makes a clear prediction about outcomes when skill level is matched with task difficulty (Csikzentmihalyi, 1990).

5.3 Inhibition

The inhibition function associated with task switching is thought to be related to the difficulty in suppressing the response set from the previous trial where the presented stimuli is incongruous with the stimuli presented for the present trial. The data analyses aimed to uncover a practice effect shown where the previously completed stimulus – response set would be left activated, as shown by a resultant increase in errors. The main effect of congruency and anxiety was not significant nor was this effect when task difficulty was increased. Analysis conducted on the data before adding anxiety as a between subject variable showed a congruency effect and furthermore there was also a significant increase in errors. However, with anxiety added into the equation the effect was not significantly which means that anxiety was not the cause of the increase in errors for incongruent trials. The analysis on error rates also failed to meet statistical significant and indicates that it is solely the challenge of suppressing the previous stimulus-response set that showed an inhibition failure of executive control and that this was not mediated by anxiety.

Although the present research failed to prove the assumption that anxiety impairs the inhibition function, either singularly or simultaneously with shifting this is not uncommon. There are many similar findings with tasks using proactive interference.

It has been argued that the difficulty in showing the affect of anxiety on inhibiting functioning is chiefly due to how anxiety interferes with cognitive performance. Anxiety is thought to impair attentional control through decreasing goal driven processing towards stimulus driven processing. However, there is a more robust correlation found between internal stimuli (i.e. worry and thoughts) than for environmentally related stimuli. In this regard the impact of the proactive interference due to the previous task set when the stimulus is incongruent may not be sufficiently emotive. ACT posits that anxiety can affect efficiency of the inhibition function with both neutral and emotional stimuli (Eysenck & Derakshan, 2011). Nonetheless this research failed to duplicate that finding.

The data did however indicate a more intriguing result. In what is arguably a more challenging tasks where one would expect to see the greatest cost effect and a decrease in inhibition functioning of the central executive, the HA group actually improved their performance and showed a switch gain. Switch gains are not expected in task switching experiments and therefore once again demonstrates the value in this child and young people based research.

A possible explanation for this finding is that the HA group are more committed to the tasks. The data showed a RISC effect which indicates that both groups are using the longer CSI to prepare their upcoming response. The main findings without anxiety as a variable are very similar to previous research in the literature. This affords the opportunity to compare this research with the findings from other task switching experiments. Although there are some mixed findings in the field most research indicates that anxiety impairs the inhibition function. The limitation is that without additional assessment or measures, it is uncertain what were factors contributing to the increased performance shown by the HA group. Nonetheless, it is clear that the HA group allocated additional attentional resources to the task given their markedly improved performance.

5.4. Updating

Updating is thought to involve the participatory act in the maintenance and collection of relevant and newly presented information for a given task. Much like Bayesian reasoning, while updating it also acts to overwrite information that is no longer relevant. Updating it is thought to be engaged in this task in the working memory (Miyake et al., 2000).

ACT predicts that this function is more moderately impaired by anxiety in comparison to the shifting and inhibition functions. Eysenck et al., (2007) reported that is it only during stressful situations that its performance is negatively influenced. This research failed to show a main effect for the updating function between the two anxiety groups although there was a trend observed in the data. Eysenck et al., (2007) reported that differences between

the anxiety groups have only been found in studies that have involved stressful conditions or emotional stimuli. As such, the failure to find the effect as predicted by ACT can be related to two main issues. First, that all of the children and young people who participated in the research seemed to enjoy it and the tasks were regarded as games and something novel for them to get to do. Secondly, it may have been prudent to have investigated the effect of adding a secondary task to the task switching program. This would have then made the test more taxing and may have produced the desired results. Alternatively, as few studies have investigated state anxiety, the difference that lies between this research and other work may rest in a fundamental difference in the attentional system. It is possible that state and trait anxiety interact with the updating function of the attentional system in a different way. Whereas state anxiety tends to be more transient, where task duration is short with immediate success there may be no main effect of anxiety. However with trait anxiety, the idea about spending a few hours undergoing some tests may be too daunting and as a consequence the decrease in performance may be seen immediately and last throughout the day.

5.5 Strengths and Limitation

There were many positives in the research and in its contribution to the literature. As far as I am aware, the observed shift in the baseline for the high anxiety group in comparison to the low anxiety group has not yet been documented in the literature. Although similar to the Yerkes-Dodson (1908) the captured data is suggestive of a richer depiction of the causal nature of the optimal anxiety versus task difficulty debate. On the basis of the research, I would argue that motivation and goal setting is the mitigating factor at play in the performance gains observed. I would also suggest that it may play a significant factor in many of the conflicting reports of the role or impact that anxiety has on performance. Contrary to most other research, the design also uniquely manipulated anxiety by increasing task difficulty instead of some external manipulation often seen (i.e. threatening stimuli, through task instruction, time limits etc). In a similar thread, this study also used a multidimensional measure of anxiety and incorporated the overall measure of

social anxiety, performance anxiety and perfectionism. It is not known to what extent this had an effect in comparison with trait anxiety however the results were promising and were able to replicate and support many of the predictions made by ACT.

Previous research has failed to find a significant impact of the shifting function in anxious children. St Clair-Thompson and Gathercole (2006) went so far to say that given the difficulty in finding a significant result, it may be likely that younger children do not yet have the cognitive capacity or architecture to have this function. This study documented a significant interaction between anxiety and the shifting function. Additionally it was found that the high anxiety group was not more impaired than the low anxiety group, but that their initial performance on the easier task (repeat trials) was so much better. The experimental methodology afforded the opportunity to uncover the performance differences between the two anxiety groups where a correlational analysis may not show the whole picture. During the experimental design phase of this work and then reviewing the literature, it was noticed that the fault in many other studies was that their shifting tasks had methodological concerns regarding the presentation of cues and other confounding variables. This research was able to overcome those by designing a task where many of these issues could be counterbalanced and therefore averaged out. It is hoped that future research will build on this in order to further develop our understanding of the interaction between anxiety and performance.

The primary limitation of the current study is likely to be the sample size. Given that the effect of anxiety may be relatively slight when using a non-clinical population, the research may be underpowered to detect a reliable effect such as in the updating function (Ellis, 2010). Sheskin (2004) states that Type II errors[30] can and do occur when sample sizes are small. Although ideal, achieving a larger sample size was not feasible for this research. There is also the notion that the task was not sufficiently challenging and so future research may wish to consider this aspect more diligently. It would also be interesting to

[30] Type II errors refer to false negatives or not finding statistically significant outcomes when they may actually exist.

have included a third group of pupils who have neither high nor low levels of anxiety. This would have completed the 'half moon' of the Yerkes-Dodson model (1908) and may have been shed additional light on the anxiety performance interplay. It seems much of the research also focussed on high versus low levels of anxiety as such would make for a good avenue for future research to begin to explore.

There are many unknowns in this area of research. It therefore seems plausible that a mixed method design would be useful in offering a more detailed picture of how anxiety is perceived by the individual. This would also serve to mitigate and short coming from choosing to use either a measure of state or trait anxiety. Being able to compare qualitative accounts of the perceived affect of anxiety combined with behavioural measures (RTs) would perhaps offer an alternative description about the possible role that anxiety mediates performance and motivation.

In broader terms and perhaps more importantly, it would also offer insight into the experience of anxiety and any compensatory strategies that children are using to overcome it in the classroom or on the playground. This would likely be very rewarding not only in terms of a rich account of working with anxiety but also for the child or young person. Being able to share their experiences and strengths is the cornerstone of many interventions aimed at supporting anxious children and young people. This literature review also discussed how social anxiety can lead to children withdrawing from their peers and has shown implications for future outcomes. By supporting children and young people to share with other who may have similar difficulties, it opens up many channels of communication in terms of peer support, comparisons between one self and others to recognize that we all share many similarities, to challenge cognitive distortions that may be held about what one can and can't do if they have social or performance anxiety and all while promoting friendships and support.

5.6 Expanding on Applied Theory

Ergene's (2003) review of effective interventions on test anxiety highlighted that the most effective programmes involve skill training combined with relaxation techniques. What the data from this research shows is that the affect that anxiety has on performance is not always reliably present. What was found was that when a child or young person, is motivated and goal driven, the anxiety that they experience may actually improve their performance through their increasing commitment and complete focus on the task.

Csíkszentmihályi (1997) proposed the positive psychology theory of flow. It is a concept used to describe the mental state of operation when a person is completely immersed in a feeling of energized focus, full involvement and success in the process of an activity or task. Csíkszentmihályi states that flow can only occur when two criteria are met. First, that the task/activity is a higher than average challenge and second, when the task/activity requires above average skills.

I would argue that the above criteria could be useful in interpreting a mixed methods experimental design. Whereas the anxiety literature blames the negative effects of anxiety on a stimulus driven process, Csíkszentmihályi suggests that flow is also driven by a 'bottom-up' or stimuli driven process that results in its execution as a goal driven exercise. In that respect, when using Csíkszentmihályi's framework it is the task that dictates at what levels both skill and challenge are positioned. With this definition, anxiety is only created when an individual faces a challenging task with a low skill level. In this regard it would be beneficial to explore the experience of anxiety and the qualitative data through the theory of flow.

Similarly, Shernoff, Czikszentmihalyi, Schneider and Shernoff (2003) state that flow can be experienced when one's skills are neither overmatched nor underutilized to meet a given challenge. They argue that when the balance of challenge and skill is uneven, an individual may experience anxiety. This is very similar to the cognitive based theory about the disruption of stimulus

versus goal driven processes. For Flow theory, anxiety is therefore dependant on the individual's skills for a given task making anxiety and the disruption of flow a 'bottom-up' process. In the cognitive literature, it is more likely to be described that anxiety is cause by the perception of insufficient skill and albeit not indicative of an actual skill deficit. As discussed in the literature review, children with social anxiety who are given social skills training frequently do not actually present with a skills deficit. In this case what the skill training does is reinforce their perception that they cannot 'do something' or don't have a particular skill that most everyone else seems to have. In line with Cartwright-Hatton et al. (2005), this can encourage the children or young person to adopt an 'observer perspective' which has its own implications. In this sense, it would be beneficial to instead focus on challenging the cognitive distortions in the thinking through a cognitive- behavioural approach. Much like the findings from this research, tasks that are challenging and require skill, concentration, clear goals and immediate feedback and offer the individual a sense of control often promote better psychological well being and performance.

5.7 Implications for the Educational Psychologist

The above paragraphs contain various snippets of information about how this research contributes to the literature and also the applied field. This section will focus on clarifying the outcomes of the research and how this can be used in training for schools, parents, teachers and children. It will start by highlighting the important of EPs engaging schools, parents and teachers in learning how to identify anxiety and to better understand its aetiology, symptomology, impact and variations.

In reference to a paragraph found in section 3.5, Ethical Considerations and with regards to a referral to a paediatrician, it is with utmost concern that EPs assist schools, through inset, training or consultation about the varied implications of anxiety. School staff and EPs should work together to better distinguish between anxieties that require academic support and those that may require specialist attention. As the data from this research suggests, in some conditions anxiety can improve academic performance and therefore a lack of

academic consequences should not be an indicator that a child or young person is coping well or does not need support. Bramston and Redman (2001) reported teachers and parents having only marginal abilities to accurately report and different levels of anxiety in children. Engaging schools in this area can serve multiple functions. Firstly, there will be an opportunity to impact many more children through developing staff competencies to identify and address most minor difficulties. Second, it opens to door to discussions about test anxiety, and in general, any forms of anxiety. From simple things like getting teachers to avoid singling out children to answer questions, to not setting presentation early on in the school year can help to make those children with social anxiety more at ease and in return more able to concentrate on focus on their learning. As previously stated, when the conditions for learning are appropriate a slight level of anxiety can be a performance enhancer.

This thesis has many direct applications to practice. First, it is worth noting that there is a wide range of presentations for different types of anxiety. The research is littered with references to trait anxiety and test anxiety being the most detrimental to long term performance however this work indicates that the same effects on performance can be seen in state anxiety. Given the ability of this work to be compared with much of the previous work in trait anxiety, it could be argued that in some cases, it does not matter if an individual has state or trait anxiety, what really matters is how it affects their performance. What it comes down to is not whether or not a child says that they hate exams. The evidence suggests that even for children and young people with anxiety, the fact that someone may report being worried about an exam does not mean that they will do poorly. In fact the evidence presented in this thesis suggests that in many instances, they may actually outperform many of their peers who report not being at all anxious about the upcoming test or assessment. However this should be taken with caution as the sample population did not include any children who might have more severe or debilitating anxiety such as a generalised anxiety disorder.

The data on the impact of anxiety in terms of cognitive performance suggests that there are several different functions that play a role in learning and

performance. Children with higher levels on anxiety can underperform in tasks that require shifting, inhibition and updating. Tasks such as writing and reading comprehension often have quite complex interactions with regards to attentional resource allocation. It is therefore important to use analogies when discussing the cognitive functions as without specialist knowledge it may not have any lasting value. With that in mind, when writing a story, learning to write words or completing a numeracy word problem, an anxious child will require extra effort to achieve at the same level or performance as a low anxiety child. They need to shift attentional resources between transferring the phonemes or sounds to words while at the same time shifting attention back to the maintenance of the story, or word as a whole. In terms of numeracy, they will need to perform numerical operations while working out what is being asked of them. While they are doing this, they need to continually update their plan and sequence for the story that they are writing or problem that they are solving. This requires updating and so there will likely be a cost involved with the shifting and updating at the same times. The child also has to inhibit various thoughts, plans and actions. It is evidenced in this paper that all of these functions have costs, and that cost is usually effort and in some instances time. When effectiveness is being negatively impacted, then it is likely that the conditions, either environmental or within child, are too great for them to cope with.

In these instances it is necessary to think about the conditions in which the high anxiety group underperformed. When tasks were not sufficiently demanding, their performance was less than that of their low anxiety peers. Matching task difficulty to learning ability or skill can be often accomplished through differentiating the work. Additionally, teachers can reduce the cognitive load on a child by using many strategies like focusing attention on important information, using checklists to maintain task oversight to even maintaining a good learning environment.

For whole class work, EPs would be very helpful in assisting educators to consider working memory when developing learning strategies. Therefore discussions could be had around linking learning to current knowledge and experience to aid in the updating function as well as ensuring that the child

remains goal driven and internally focused instead of drawing their attention away from their information processing and task completion. Further research in this area may be beneficial in order to more fully appreciate exactly how this might occur.

With this in mind it is worth mentioning the demands placed on the pupils during phases one and two. The computerized task switching was completed first so that the children were 'fresh' and fully engaged. The reason why this is mentioned is that the literature suggests a strong link between WM and performance. Therefore it was surprising to see the hypothesis regarding the updating function not being met. It was expected that this may be one of the more robust findings given the research on anxiety and performance in relation to numeracy, literacy and WM. However, an alternate explanation is that by the time the final simultaneous processing measure was being performed the children were likely tired and less interested. This highlights the need to discuss with schools particular needs on reducing cognitive load and teaching in challenging but short bursts throughout a planned exercise. Certainly matching lessons and differentiating lessons to match a child's zone of proximal development would further ensure increased focus and a sense of mastery, self-esteem and confidence in their ability to learn. What was also apparent in the data was that new, novel tasks or surprising events (to make things seem interesting) all seemed to increase the children's' intrinsic motivation. As discussed earlier, creating periods of 'Flow' is the aim, and getting the balance between the level of challenge and motivation is critical to make that happen.

Finally, motivation and goal setting seem paramount to the longer term success of anxious children and young person in terms of increasing performance and reducing costs. Ergene (2003), Barrett and Turner (2001) and Gregor (2005; 2011) all comment about the increased role for parents and enabling them to support their children. The above four authors all highlight the impact of CBT type interventions and even the success of interventions led by people other than psychologist. The data showed that when motivated and committed to a task, performance was not impaired by anxiety but improved. Many parents want to be involved and therefore getting them to talk to their child about what

they are finding challenging may be both enlightening and beneficial. The aim here would be to process the intrusive though of worry, to make a plan, to decide on a goal and then to discuss how to achieve it. Parents can help their child through this process by asking questions and filling in gaps where appropriate. The present research suggests that goal directed processing improves performance. It is likely that goals support performance by strengthening directed focus. Once the child makes progress towards their goal, they may feel more motivated and begin to work even harder. Additionally, the goal directed focus reframes anxiety and instead packages it as something positive and empowering. Further research into the use of goals in increasing cognitive performance may be appropriate.

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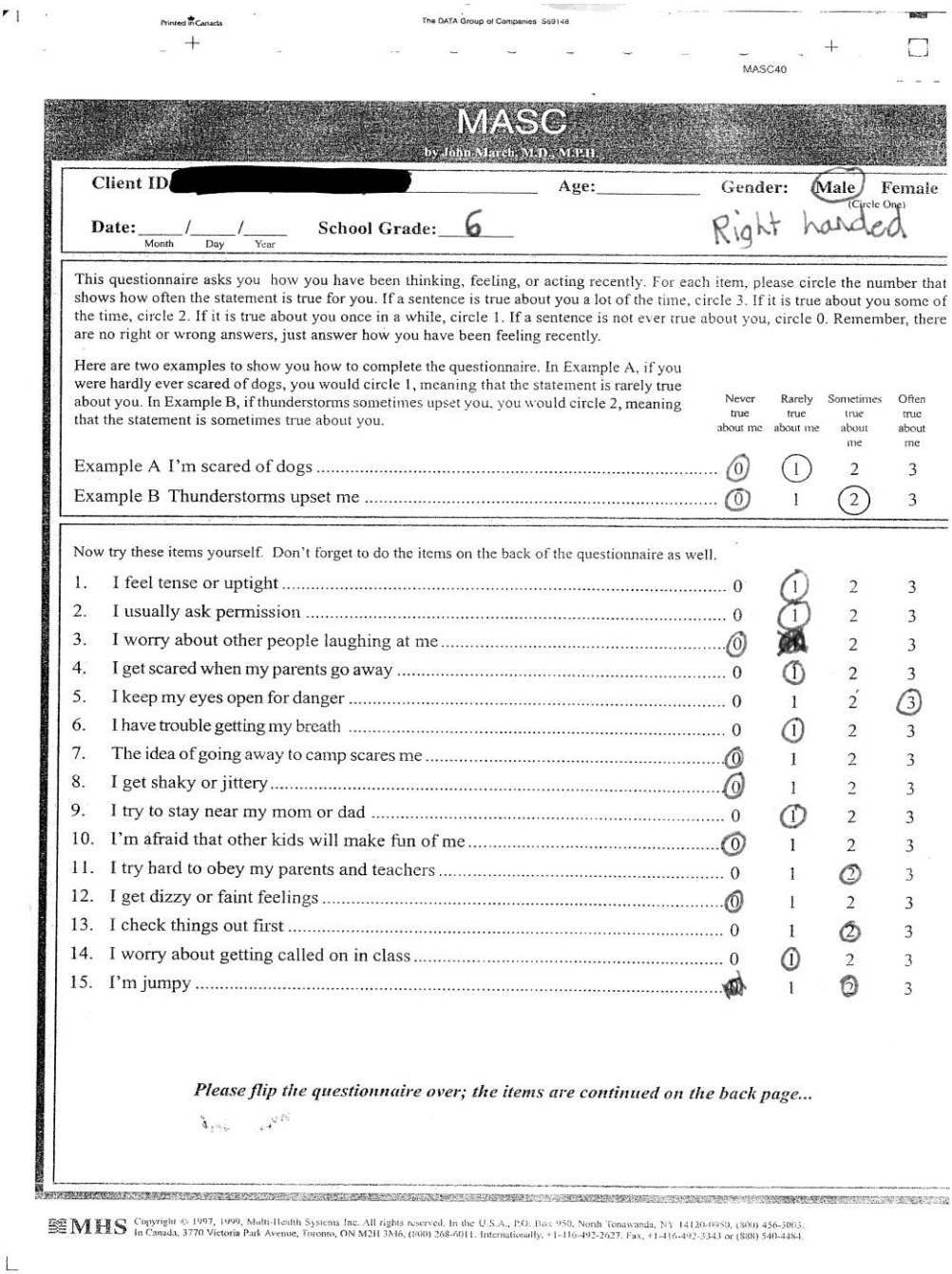
Appendix A - MASC



Printed in Canada The DATA Group of Companies S69148

MASC40

MASC

by John March, M.D., M.P.H.

Client ID [redacted] Age:_____ Gender: Male Female (Circle One)

Date:____/____/____ School Grade: 6

Month Day Year

Right handed

This questionnaire asks you how you have been thinking, feeling, or acting recently. For each item, please circle the number that shows how often the statement is true for you. If a sentence is true about you a lot of the time, circle 3. If it is true about you some of the time, circle 2. If it is true about you once in a while, circle 1. If a sentence is not ever true about you, circle 0. Remember, there are no right or wrong answers, just answer how you have been feeling recently.

Here are two examples to show you how to complete the questionnaire. In Example A, if you were hardly ever scared of dogs, you would circle 1, meaning that the statement is rarely true about you. In Example B, if thunderstorms sometimes upset you, you would circle 2, meaning that the statement is sometimes true about you.

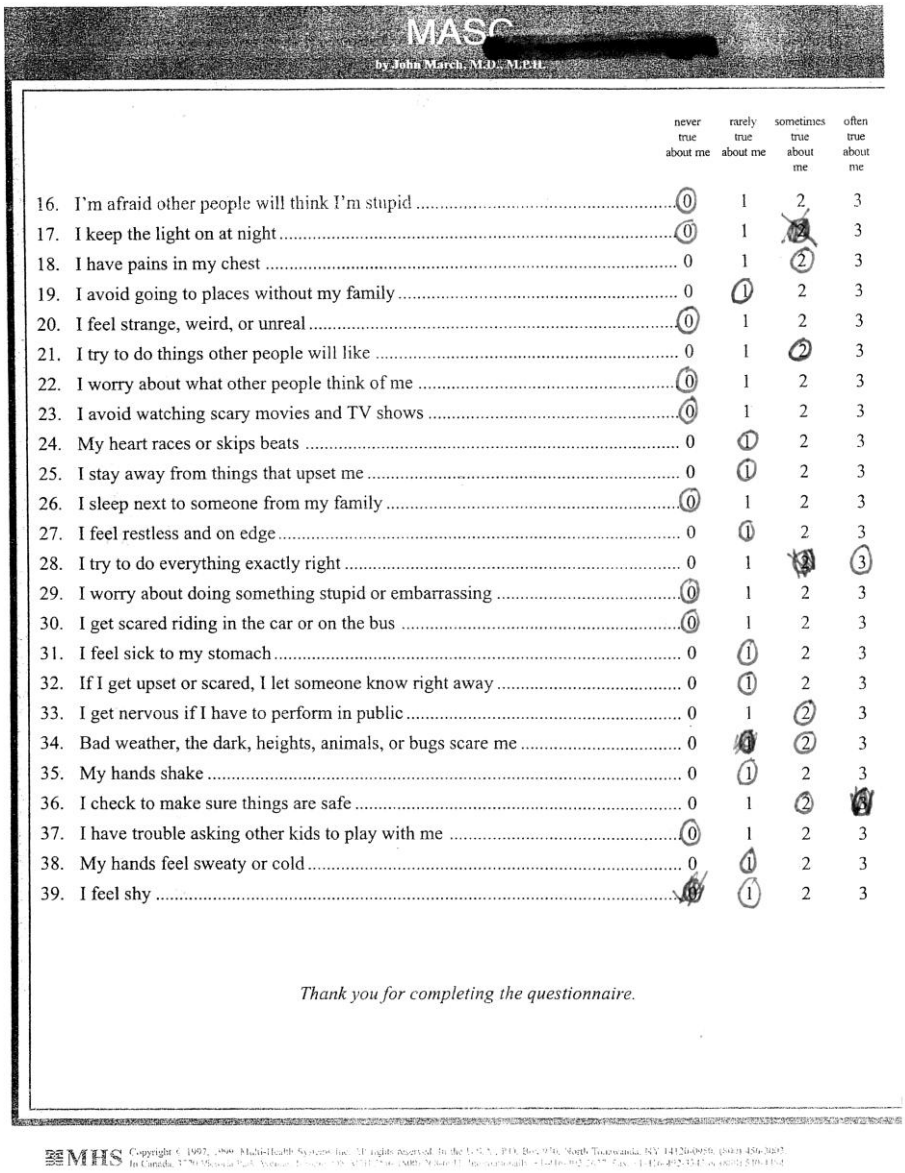
	Never true about me	Rarely true about me	Sometimes true about me	Often true about me
Example A I'm scared of dogs	(0)	(1)	2	3
Example B Thunderstorms upset me	(0)	1	(2)	3

Now try these items yourself. Don't forget to do the items on the back of the questionnaire as well.

1. I feel tense or uptight	0	(1)	2	3
2. I usually ask permission	0	(1)	2	3
3. I worry about other people laughing at me	(0)	[illegible]	2	3
4. I get scared when my parents go away	0	(1)	2	3
5. I keep my eyes open for danger	0	1	2	(3)
6. I have trouble getting my breath	0	(1)	2	3
7. The idea of going away to camp scares me	(0)	1	2	3
8. I get shaky or jittery	(0)	1	2	3
9. I try to stay near my mom or dad	0	(1)	2	3
10. I'm afraid that other kids will make fun of me	(0)	1	2	3
11. I try hard to obey my parents and teachers	0	1	(2)	3
12. I get dizzy or faint feelings	(0)	1	2	3
13. I check things out first	0	1	(2)	3
14. I worry about getting called on in class	0	(1)	2	3
15. I'm jumpy	[illegible]	1	(2)	3

Please flip the questionnaire over; the items are continued on the back page...

Appendix A2 – Multidimensional Anxiety Scale for Children



MASC

by John March, M.D., M.P.H.

	never true about me	rarely true about me	sometimes true about me	often true about me
16. I'm afraid other people will think I'm stupid	0	1	2	3
17. I keep the light on at night	0	1	2	3
18. I have pains in my chest	0	1	2	3
19. I avoid going to places without my family	0	1	2	3
20. I feel strange, weird, or unreal	0	1	2	3
21. I try to do things other people will like	0	1	2	3
22. I worry about what other people think of me	0	1	2	3
23. I avoid watching scary movies and TV shows	0	1	2	3
24. My heart races or skips beats	0	1	2	3
25. I stay away from things that upset me	0	1	2	3
26. I sleep next to someone from my family	0	1	2	3
27. I feel restless and on edge	0	1	2	3
28. I try to do everything exactly right	0	1	2	3
29. I worry about doing something stupid or embarrassing	0	1	2	3
30. I get scared riding in the car or on the bus	0	1	2	3
31. I feel sick to my stomach	0	1	2	3
32. If I get upset or scared, I let someone know right away	0	1	2	3
33. I get nervous if I have to perform in public	0	1	2	3
34. Bad weather, the dark, heights, animals, or bugs scare me	0	1	2	3
35. My hands shake	0	1	2	3
36. I check to make sure things are safe	0	1	2	3
37. I have trouble asking other kids to play with me	0	1	2	3
38. My hands feel sweaty or cold	0	1	2	3
39. I feel shy	0	1	2	3

Thank you for completing the questionnaire.

Appendix B – MASC Corrections for UK

The following corrections were made to the questionnaire items so that the children more readily understood them.

Item 7. From 'The idea of going away to camp scares me' to ' The idea of going away on school residential scares me'.

Item 14. From 'I worry about getting called on in class' to ' I worry about being asked by my teacher to give an answer in the class'.

Appendix C – Cognitive Assessment System – Non-Verbal Matrices

Record Form

[redacted]

CAS Non-verbal Matrices

Page Number	**Solution**					
Sample	(1)	2	3	4	5	6
1	1	2	3	(4)	5	6
2	1	(2)	3	4	5	6
3	1	2	(3)	4	5	6
4	1	2	3	4	(5)	6
5	1	2	3	4	(5)	6
6	1	2	(3)	4	5	6
7	(1)	2	3	4	5	6
8	1	2	3	(4)	5	6
9	1	(2)	3	4	5	6
10	1	2	3	(4)	5	6
11	1	2	3	4	(5)	6
12	1	(2)	3	4	5	6
13	1	2	3	(4)	5	6
14	1	(2)	3	4	5	6
15	(1)	2	3	4	5	6
16	1	2	3	4	5	(6)
17	1	(2)	3	4	5	6
18	1	2	(3)	4	5	6
19	1	2	3	4	5	(6)
20	1	2	3	(4)	5	6
21	1	2	3	(4)	5	6
22	1	(2)	3	4	5	6
23	1	2	3	4	5	(6)
24	1	2	3	4	5	(6)
25	(1)	2	3	4	5	6
26	1	(2)	3	4	5	6
27	1	2	(3)	4	5	6
28	1	2	(3)	4	5	6
29	1	(2)	3	4	5	6
30	1	2	(3)	4	5	6
31	(1)	2	3	4	5	6
32	(1)	2	3	4	5	6
33	1	(2)	3	4	5	6

Planned Connections

Materials Administration and Scoring Manual, pages 24-29
Response Book for Ages 5–7, pages 8-14
Response Book for Ages 8–17, pages 9-17
Red pencil, Stopwatch

Administer Ages 5–7: Demonstration, Sample A, Items 1-5
Ages 8–17: Sample A, Items 4-6,
Sample B, Items 7-8

Time Limits See below

Record Time in seconds
Strategy Assessment

	Item	Time Limit	Time in seconds Ages 5–7	Time in seconds Ages 8–17
5–7 Years	Demonstration			
8–17 Years	Sample A			
	1.	60" (1:00)		
			+	
	2.	60" (1:00)		
			+	
	3.	90" (1:30)		
			+	
	4.	90" (1:30)		
			+	+
	5.	150" (2:30)		
5–7 Stop				+
	6.	150" (2:30)		
	Sample B			
				+
	7.	150" (2:30)		
				+
	8.	180" (3:00)		
8–17 Stop			=	=
	Raw Score			
			Sum of Items 1-5, Total Seconds	Sum of Items 4-8, Total Seconds

Strategy Assessment Checklist

Obs	Rep	Description of Strategy
		1. Scanned page for next number or letter
		2. Remembered last number or letter
		3. Lifted hand off the page to see better
		4. Looked back at last number or letter
		5. Repeated alphabet/number series out loud
		6. Repeated alphabet/number series to self
		7. No strategy

Other:
Observed _____

Reported _____

Nonverbal Matrices

Materials Administration and Scoring Manual, pages 31-34
Stimulus Book, pages 1-67

Start Ages 5–7: Sample, Item 1
Ages 8–17: Sample, Item 7

Discontinue After 4 consecutive items failed

Drop Back If a child ages 8–17 fails Item 7, then give Item 1 (using the directions for ages 5–7) and administer forward until the discontinue rule has been met.

Record Child's response

Score Pass = 1, Fail = 0

	Item	Correct Response	Child's Response	Score 1 or 0
All Ages	Sample	1		
5–7 Years	1.	4		
	2.	2		
	3.	3		
	4.	5		
	5.	5		
	6.	3		
8–17 Years	7.	1		
	8.	4		
	9.	2		
	10.	4		
	11.	5		
	12.	2		
	13.	4		
	14.	2		
	15.	1		
	16.	3		
	17.	2		
	18.	3		
	19.	5		
	20.	4		
	21.	4		
	22.	2		
	23.	6		
	24.	2		
	25.	3		
	26.	6		
	27.	3		
	28.	1		
	29.	1		
	30.	2		
	31.	5		
	32.	6		
	33.	4		

Raw Score

Sum all item scores, giving credit (1) for each item not administered below the starting point

Appendix D – CAS Verbal Spatial Relationship Record Form

Verbal-Spatial Relations

Materials Administration and Scoring Manual, pages 35-40
Stimulus Book, pages 69-123
Stopwatch

Start Ages 5–7: Sample, Item 1
Ages 8–17: Sample, Item 7

Discontinue After 4 consecutive items failed

Drop Back If a child ages 8–17 fails Item 7, then give Item 1 (using the directions for ages 5–7) and administer forward until the discontinue rule has been met.

Time Limit 30 seconds per item

Record Child's response

Score Pass = 1, Fail = 0

	Item	Correct Response	Child's Response	Score 1 or 0
All Ages	Sample	1	1	
5–7 Years	1.	3		1
	2.	2		1
	3.	4		1
	4.	5		1
	5.	6		1
	6.	2		1
8–17 Years	7.	1	1	1
	8.	4	4	1
	9.	3	3	1
	10.	5	5	1
	11.	1	1	1
	12.	3	3	1
	13.	2	2	1
	14.	6	3	0
	15.	2	2	1
	16.	5	5	1
	17.	3	3	1
	18.	4	6	0
	19.	5	5	1
	20.	2	3	0
	21.	1	2	0
	22.	4	6	0
	23.	6	2	0
	24.	5		
	25.	4		
	26.	1		
	27.	6		

Raw Score 17

Sum all item scores, giving credit (1) for each item not administered below the starting point

Figure Memory

Materials Administration and Scoring Manual, pages 41-50
Stimulus Book, pages 125-237
Figure Memory Response Book, pages 1-57
Red pencil
Stopwatch

Start Ages 5–7: Demonstration, Sample, Item 1
Ages 8–17: Demonstration, Sample, Item 3

Discontinue After 4 consecutive items failed

Drop Back If a child ages 8–17 fails Item 3, then give Item 1 (using the directions for ages 5–7) and administer forward until the discontinue rule has been met.

Time Limit Expose each stimulus for 5 seconds

Score Pass = 1, Fail = 0

	Item	Score 1 or 0
All Ages	Demonstration	
	Sample	
5–7 Years	1.	
	2.	
8–17 Years	3.	
	4.	
	5.	
	6.	
	7.	
	8.	
	9.	
	10.	
	11.	
	12.	
	13.	
	14.	
	15.	
	16.	
	17.	
	18.	
	19.	
	20.	
	21.	
	22.	
	23.	
	24.	
	25.	
	26.	
	27.	

Raw Score

Sum all item scores, giving credit (1) for each item not administered below the starting point

Appendix E –Instructions for Task-switching Experiment

Instructions for Practice task- switching set:

BEFORE E-PRIME STARTS

In this computer game, you will see pretend animals.

These animals will have DOTS or STRIPES on their bodies, and will have either SHORT or LONG legs. You will play two games: in one game you will concentrate on the body and in the other you will concentrate on the legs. In both games you will need to press the two buttons on the front of the laptop. The rules about when to press the buttons will be displayed before the game starts.

BEFORE SINGLE TASK PRACTICE

<START E-PRIME> Read the rules for the body game. Are they clear? Place the index fingers of both hands on the buttons <SHOW THEM AND MAKE SURE THEY DO IT>. Try to be quick and don't make too many errors. When you are done, wait for the others to finish before we go onto the next level.

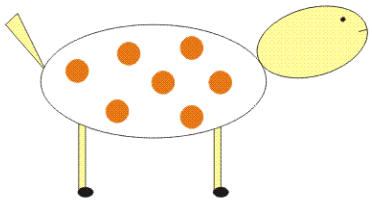
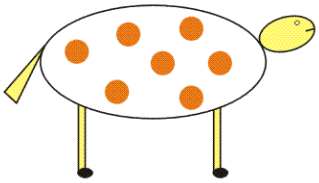
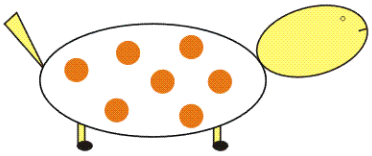
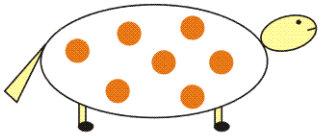
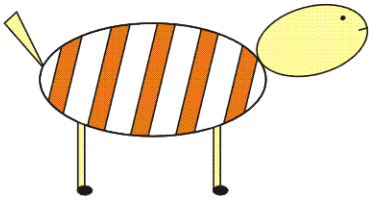
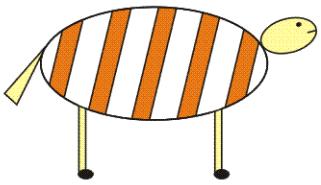
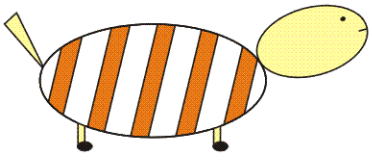
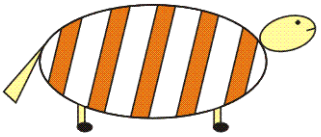
BEFORE SWITCHING PRACTICE

<START E-PRIME> The level of the game in which the body and legs games are separate is over. Now, in the next level, the two games will switch. A voice in the headphones will tell you which game to do. If the voice says "BODY" or "COAT", then do the body game. But, if the voice says "LEGS "or "SHOES" then do the legs game. Is this clear? Sometimes there will be a time gap between the voice and the animal. This is to help you prepare better for the right game. Use the extra time! In this level you will only get a message if you press the wrong button. If there is no message on the screen- this means you pressed the right button. If you are ready, let's practice the switching level. When you are done, wait for the others to finish before we go onto the next level.

BEFORE THE MAIN TESTING

<START E-PRIME> You've practiced the switching level. Now let's play it properly. It will take a little longer. Try to be quick and don't make too many errors.

Appendix F – Complete Sample of Experimental Stimuli

Appendix G – Ethical Approval.

STUDENT HIGHER-LEVEL RESEARCH

UNIVERSITY OF EXETER

Graduate School of Education

Certificate of ethical research approval

STUDENT RESEARCH/FIELDWORK/CASEWORK AND DISSERTATION/THESIS
You will need to complete this certificate when you undertake a piece of higher-level research (e.g. Masters, PhD, EdD level).

To activate this certificate you need to first sign it yourself, and then have it signed by your supervisor and finally by the Chair of the School's Ethics Committee.

For further information on ethical educational research access the guidelines on the BERA web site: http://www.bera.ac.uk/blog/category/publications/guidelines/ and view the School's statement on the 'Student Documents' web site.

READ THIS FORM CAREFULLY AND THEN COMPLETE IT ON YOUR COMPUTER (the form will expand to contain the text you enter). **DO NOT COMPLETE BY HAND**

Your name: Dana Porter

Your student no: 540029485

Return address for this certificate: 30 Southbrook Road, Bovey Tracey, TQ13 9YZ

Degree/Programme of Study: Doctorate in Educational Psychology

Project Supervisor(s): Tim Maxwell and Andrew Richards

Your email address: d.l.porter@ex.ac.uk

Tel: 01626 835 178

I hereby certify that I will abide by the details given overleaf and that I undertake in my thesis to respect the dignity and privacy of those participating in this research.

I confirm that if my research should change radically, I will complete a further form.

Signed:.....**date:20/10/2011**.....

NB *For Masters dissertations, which are marked blind, this first page must* ***not be included*** *in your work. It can be kept for your records.*

Chair of the School's Ethics Committee
last updated: August 2009

Spreadsheet. It will not be stored in the public domain. For research purposes, all participants will be assigned a participant number that will be the only identifiable feature of the data to be saved.

Give details of any exceptional factors, which may raise ethical issues (e.g. potential political or ideological conflicts which may pose danger or harm to participants): There are no exceptional factors that I consider could raise ethical issues.

***This form should now be printed out**, signed by you on the first page and sent to your supervisor to sign. Your supervisor will forward this document to the School's **Research Support Office** for the Chair of the School's Ethics Committee to countersign. A unique approval reference will be added and this certificate will be returned to you to be included at the back of your dissertation/thesis.*

N.B. You should not start the fieldwork part of the project until you have the signature of your supervisor

---

This project has been approved for the period: **until:** Oct 2013

By (above mentioned supervisor's signature): T S Maxwell **date:** Oct 2011

*N.B. **To Supervisor:** Please ensure that ethical issues are addressed annually in your report and if any changes in the research occurs a further form is completed.*

SELL unique approval reference:.....

Signed:.....**date:**.....
Chair of the School's Ethics Committee

This form is available from http://education.exeter.ac.uk/students/

Chair of the School's Ethics Committee
last updated: August 2009

Appendix H – Blank Parental Permission Form

Dear Parent(s)/Guardian(s),

Your child's school has been invited to take part in a project, *Becoming a Better Reader*, that I, Dana Porter (your schools Educational Psychologist) is running as part of my Doctoral Thesis at the University of Exeter. The project's aim is to improve reading fluency and is investigating what additional skills are related to reading. The hope is that by indentifying what skills mediate reading fluency we can offer better support for those children who find learning to read more difficult.

As part of the project, children will be invited to complete a few tasks. They include a self –report anxiety questionnaire asking about worries and feelings such as 'Do you worry about being called on in class to read aloud?' Other assessments include phonic games, short reading and comprehension items, multiple choice puzzles (i.e. which of the 6 blocks best fits in the missing section of the puzzle) as well as listening and recalling strings of digits (i.e. 4-5-3). There will also be a computer-based task to which children will be asked to respond to animals with either short or long legs, or, stripes and spots. All children will be informed that they are free to stop at any time and that there is no need for them to complete any of the puzzles/assessments if they so wish. It is hoped that the children will find the puzzles fun and exciting.

The project is aimed at year 5 and 6 pupils and everyone in these classes will be invited to take part though only a few will complete all of the puzzles. We ask that if you ***agree*** to have your child to take part with this exciting and beneficial project, please sign and return this form to your child's teacher. If you have any questions, or would like to know more, please feel free to contact me, Dana Porter, at anytime on email at *d.l.porter@ex.ac.uk* or on my mobile at *07521295267*.

Your help would be greatly appreciated.

Yours Faithfully,

Dana Porter

Trainee Educational Psychologist

I **agree and give permission for my child** to take part in the *Becoming a Better Reader* project.

Child's name: _____ Date: _____

Class teacher: _____

Parent(s) or Guardian(s) Signature: _____

Appendix I – School Context and Social Demographic

All of the four schools who agreed to support this research were located in the South West of the UK. The following will give a brief description of the schools with the actual names being changed to preserve anonymity.

School 1: An above average sized centrally located market-town based primary school. The percentage of pupils known to be eligible for free school meals is high and the pupil's background is typically of white British heritage. There is also a higher than average proportion of pupils with a statement of special educational needs. A new head teacher was only recently appointed and a determined focus on literacy, writing and numeracy is evident. Also present is the desire to get parents more engaged with school and as such the school is now offering parent literacy and numeracy classes. Historically, the focus has been on the social, emotional, behavioural and early learning skill development of the pupils.

School 2: An above average sized primary school located on the edge of a market town. Pupils at this school are typically of white British heritage. The proportion of pupils with special educational needs is average and the proportion of pupils receiving support from the pupil premium funding (aimed at supporting pupils eligible for free school meals) is below average. Given the school's outstanding Ofsted reports the school is now attracting pupils from outside its usual catchment.

School 3: A slightly larger than average sized village based primary school. The proportion of pupils eligible for free school meals is below average and the majority of pupils are of white British heritage. The proportion of pupils with special educational needs is below average but includes a higher than average proportion of pupils with statements of special educational needs. The school is a church school where the majority of parents profess to have beliefs in line with the Church of England.

School 4: A larger than average sized primary school located within the boundaries of a city in the South West. The majority of pupils are of white British heritage and the proportion of pupils with special educational needs is above average. Also above average is the proportion of pupils eligible for the pupil premium. The school has recently been unsettled due to the hasty departure of their long-standing head teacher. The school's interim leadership team is working hard to restore confidence in their ability.

Appendix J- List of Abbreviations and Terms

ACT – Attentional Control Theory

AS - Articulatory Supression

CAMHS - Child and Adolescent Mental Health Services

CAS - Cognitive Assessment System

CSI - Cue to Stimulus Interval (preparation effect)

CT - Cue Type

DCC - Devon County Council

DCSF - Department for Children, Schools and Families

EP - Educational Psychologist

HA – High Anxiety

IQ – Intelligence Quotient

LA – Low Anxiety

M – Mean

MASC - Multidimensional Anxiety Scale for Children

MD – Median

NVM - Non-Verbal Matrices

PEP – Principal Educational Psychologist

RCI - Response to Cue Interval

RISC - Reduction in Switch Cost

RT – Reaction Time

SATs - Standardized Achievement Tests

SD – Standard Deviation

SENCO - Special Educational Needs Coordinator

S-R – Stimulus Response

TS – Task Switching

TSR - Task Set Reconfiguration

TSI - Task Set Interference

UK – United Kingdom

WM - Working Memory