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An Exploration of Anxiety, Attention, Working Memory and School Performance in Children

by

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ABSTRACT

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By Samantha Helen Ann Beasley

The recent economic downturn and rise in unemployment has increased competition for jobs, where those with academic qualifications are more likely to find work (Eurostat, 2014). Theoretical models (e.g., Attention Control Theory; Eysenck, Derakshan, Santos, & Calvo, 2007) have been developed to understand what influences academic performance and highlight the importance of affective and cognitive factors in academic performance in schools. This is supported by research which has shown links between anxiety, cognition (e.g., working memory, attention) and achievement. A review of the literature indicated the emergence of a theoretical framework that begins to explain links between anxiety and academic achievement, with some studies suggesting that working memory (e.g., Owens, Stevenson, Norgate, & Hadwin, 2008) and attention (Grills-Taquechel, Fletcher, Vaughn, Denton & Taylor, 2013) mediate the anxiety-achievement pathway. However none of the studies measured all of these variables and entered them into a mediation analysis. The current study measured variables related to mind wandering using a go/no-go task with children (n = 34, age = 9-10 years), as has been done previously with adults (McVay & Kane, 2009), to understand the relationship between this construct and other attentional indices (self-report attention control, cognitive failures), verbal working memory (listening recall, backwards digit), school performance (academic performance, attendance) and anxiety (self-report, teacher-report). Anxiety was related to self-report measures of attention, including mind wandering, maths and attendance. Although self-report anxiety was not related to verbal working memory, as was hypothesised, higher working memory was related to greater reaction time variability (individuals' attentional fluctuations) and better academic performance. No significant indirect pathways were found between anxiety and academic performance via self-report attentional control or cognitive failures. Limitations of the study are considered and implications for researchers and educational psychologists are discussed.

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Declaration of Authorship

I, SAMANTHA HELEN ANN BEASLEY, declare that the thesis entitled '**An exploration of anxiety, attention, working memory and school performance in children**' and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- none of this work has been published before submission.

Signed: ……..

Date:…….

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Abbreviations

α	Cronbach's alpha
ACS	Attention Control Scale
ACT	Attention Control Theory
ADHD	Attention deficit/hyperactivity disorder
ANOVA	Analysis of Variance
APA	American Psychiatric Association
ASD	Autism spectrum disorder
AWMA	Automated Working Memory Assessment
β	Standardised regression coefficient
B	Unstandardised regression coefficient
CBCL	Child Behaviour Checklist
CFQ	Cognitive Failures Questionnaire
Δ	Value of change
D	Overall largest deviation
df	Degrees of freedom
DfE	Department for Education
DSM	Diagnostic and Statistical Manual of Mental Disorders
EP	Educational psychologist
F	*F*-ratio (*F*-distribution)
f^2	Cohen's effect size for hierarchical multiple regression
KS1	Key Stage 1
M	Mean

ms	Milliseconds
n	Number of cases
N	Total sample size
NC	National Curriculum
p	A probability quantifying the strength of evidence against the null hypothesis
PET	Processing Efficiency Theory
r	Pearson's product-moment correlation coefficient
R^2	The percentage of total variation explained by a variable or statistical model
RCADS	Revised Children's Anxiety and Depression Scale
RCMAS	Revised Children's Manifest Anxiety Scale
RT	Reaction Time
SAS-TR	School Anxiety Scale - Teacher Report
SAT	Standard Assessment Test
SD	Standard deviation
SDQ	Strengths and Difficulties Questionnaire
SE	Standard error
T	Transformation of raw score into standardised score
t	Value of t-statistic
TUT	Task-unrelated thought
UK	United Kingdom
USA	United States of America

Chapter 1: Literature Review

Understanding the Impact of Anxiety, Attention and Working Memory on Academic Performance

The recent global financial crisis has negatively impacted on the future prospects of young people across the world, including employment. A report by the International Labour Organisation (ILO; 2014, pg. 89) proposed that "economic growth and improvements in welfare increasingly depend on the degree of literacy and educational attainment of the total population". Consistent with this view, 2012 data from the European Union member states indicates that academic qualifications represent the best insurance against unemployment rates, which are inversely related to the level of education attained (Eurostat, 2014). UK figures similarly show that rates of unemployment for individuals who achieve university or college level qualifications were lower than for those who had left school after secondary education and were less than a third of the rates of unemployment of those who only achieved primary education (ILO, 2014). Moreover, recent figures showed that at the end of 2012, 9.6% of 16-18 year olds were not in education, employment or training in England (Department for Education [DfE], 2013), even though these activities are recognised to buffer a range of negative consequences including youth crime, early parenthood and poor health, according to research led by the Office of the Children's Commissioner (11 MILLION, 2007). Research is needed to further understand the cognitive and emotional factors which impact on academic performance, which may act as protective factor for young people against the negative life outcomes described above.

Understanding Anxiety

Woodward and Fergusson (2001) suggest that children and adolescents diagnosed with anxiety disorders are, similarly, at higher risk of poor health, early parenthood, suicidal behaviour, crime, drug and alcohol use into adulthood. These associations persist even when protective social, familial and individual factors are statistically taken into account. The *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association [APA], 2013) defines anxiety as the anticipation of future threat. Anxiety is distinct from fear, which is defined as the emotional response to a real or perceived imminent threat. Anxiety can be present in healthy populations, or in more extreme cases symptoms may constitute an

anxiety disorder. For anxiety to be characterised as disordered, it must be excessive or persist beyond developmentally appropriate periods, usually for six months or more.

There are a number of anxiety disorders in the DSM-5, with diagnosis dependent on the types of objects or situations which induce anxiety. Anxiety, whether or not this reaches a clinical disordered level, is thought to be underpinned by characteristic cognitive ideation symptoms (e.g., vigilance, worry), behaviour symptoms (e.g., avoidance) and physical symptoms (e.g., muscle tension; APA, 2013).

Anxiety disorders are reported to be the most common forms of psychopathology in children and adolescents (Fergusson, Horwood, & Lynskey, 1993). A meta-analysis has found that around 10% of participants across studies aged 2-21 years were found to meet the criteria for an anxiety disorder (Costello, Egger, Copeland, Erkanli, & Angold, 2011). Females are twice as likely as males to experience anxiety disorders (APA, 2013). Anxiety does not need to reach a clinical level in order to impact individuals' outcomes, however. Research, including the current study, has investigated the impact of anxiety in healthy populations where the results may be generalised to those not diagnosed with specific anxiety disorders.

Anxiety and Academic Performance

It has been widely established in the literature that anxiety impacts on academic achievement, where the majority of the research shows negative correlations between anxiety and academic performance in adults and children. For example, in a sample of 554 adults, as test anxiety increased, academic performance as measured by participants' final high school grade point average significantly decreased (Fischer, Schult, & Hell, 2013). Similarly, higher levels of anxiety were significantly related to lower academic performance in a sample of 12-13 year old adolescents (r = -0.43; Owens, Stevenson, Hadwin, & Norgate, 2012). Kusché, Cook and Greenberg (1993) compared younger children aged 6-10 years with high levels of anxiety/somatic/withdrawn symptomology with controls, using teacher- and child-report measures, and found that anxious children performed significantly worse on standardised measures of reading, maths and spelling.

Anxiety and Academic Performance over Time

Some research using a longitudinal design and statistical models suggests that trait anxiety may be the causal variable in the relationship between trait anxiety and

academic (exam) performance of 86 graduate students (Heinrich, 1979). However, Romano, Babchishin, Pagani and Kohen (2010) also used a longitudinal design and found that higher maths skills at age 6-7 years significantly predicted anxiety/depression at age 8-9 years, suggesting that ability impacts on anxiety, rather than the other way round. Similarly, Burt and Roisman (2010) used a longitudinal design and structural equation modelling with a sample of 1,364 children to explore the direction of the relationships between emotional, behavioural and academic variables. The authors measured children's internalising and externalising behaviours and academic performance aged 4-5 years, 6-7 years, 8-9 years, 10-11 years and 15 years. Their best fit statistical model suggested that early externalising problems (including aggressive behaviour), affect academic performance and social competence which in turn develops into later internalising problems (including anxiety/depression). However, the combination of variables related to internalising and externalising behaviours and the use of an academic performance composite score make understanding the developmental pathways between specific emotions and academic areas complex.

Kempe, Gustafson and Samuelsson's (2011) study of 360 children when they were aged 6-7 years, 7-8 years and 8-9 years showed that anxiety/depression did not significantly impact on standardised measures of academic performance in phonics, sight reading, comprehension and spelling concurrently or over time. This is in contrast to other studies which have found that poor academic performance led to anxiety or vice versa. Anxiety and depression were not separated in this study, however.

Exploring Links between Anxiety and Academic Performance

In their concurrent analyses, Grills-Taquechel and colleagues (2013) found that students who reported more separation anxiety symptoms had poorer performance in basic reading, comprehension, reading fluency and calculation. In contrast, students reporting greater harm avoidance (e.g., perfectionism) showed better achievement scores on all subject areas. While it is important to bear in mind the age and size (n = 161, age range 6-8 years) of this highly ethnically diverse American sample, these results do suggest that the different components of anxiety impact on academic achievement in different ways, perhaps acting as a motivator for children at certain ages (Grills-Taquechel, Fletcher, Vaughn, Denton, & Taylor, 2013).

There is some evidence to suggest that anxiety impacts on different areas of academic performance in different ways. Hinshaw, Morrison, Carte and Cornsweet (1987) found with a sample of 547 children aged 5-6 years that anxiety/withdrawal was highly negatively correlated with achievement on the sounds and letters ($p < 0.01$) component of the Stanford Early School Achievement Test, but not the reading or maths components. Furthermore, when Owens and colleagues (2012) conceptualised academic performance as a composite score of measures of spelling, maths and Standard Assessment Tests (SATs) results in mathematics, English and science, anxiety and depression were no longer found to be correlated significantly to academic performance. When academic performance was divided into subjects, the authors found that worry mediated the link between anxiety and academic performance, specifically for science and mathematics, but not for English.

The differentiated impact of anxiety on various subjects or topics of learning has led some authors to propose that there are different types of anxiety which relate specifically to distinct subject areas. For example, researchers refer to constructs such as *maths anxiety* and *foreign language anxiety* and use specialised questionnaires for measuring these separate constructs. For example, Vukovic and colleagues (2013) explored 113 7-9 year olds' performance on a number of different mathematics problems including computation, story problems, algebra, data analysis and geometry. The negative association between mathematics anxiety and mathematics performance was only found, however, for calculation skills and mathematical applications, not geometric reasoning. Since geometry involves spatial and attribute relations rather than numbers, it may be that maths anxiety and spatial anxiety are distinct constructs. Overall, however, the study found a negative association between maths anxiety and maths performance (after controlling for reading ability, early numeracy and working memory), suggesting that maths anxiety has a unique contribution to the variance in maths performance **(**Vukovic, Kieffer, Bailey, & Harari, 2013).

Furthermore, a meta-analysis showed that the negative association between achievement and anxiety may be linked to specific situations, such as test anxiety (Seipp, 1991). For example, Hembree (1988) reviewed over 500 studies to show that test anxiety correlated negatively with academic performance, including aptitude/achievement in reading and English (r = -.24) and mathematics (r = -.22). A study by Mulvenon, Stegman and Ritter (2005) investigated the perceptions of

American teachers, students, parents and other school staff of student well-being since academic testing in schools was increased in the USA following the *No Child Left Behind* Act of 2001. These groups reported that students were experiencing an elevated level of anxiety, stress and even illness that was linked to increased standardised tests and examinations. This situation could be potentially exacerbated in the UK following the Government's recent policy change to make General Certificate of Secondary Education (GCSE) qualifications predominantly examination based from 2015 (DfE, 2013). Although recent Government investment aims to support youth mental health in the UK (Cabinet Office, 2013), it will be important for schools to understand the effect of anxiety on young people's education and how to identify factors that underpin the association between anxiety and achievement in order to develop effective prevention and intervention protocols.

Theoretical Background

In order to understand the negative impact of anxiety on academic performance, researchers have developed theoretical models which consider the role of cognitive processes. Eysenck and Calvo's (1992) Processing Efficiency Theory (PET) focuses on understanding links between anxiety and cognitive processing. It posits that worrying (a cognitive component of anxiety) places a high demand on cognitive resources, with resulting task-unrelated thoughts impairing the working memory by taking up space in its limited capacity. According to this theory, anxiety negatively impacts performance effectiveness (i.e., the quality of an individual's task performance) and, to a greater extent, processing efficiency (i.e., performance effectiveness divided by the amount of effort used).

More recently, theorists have noted that anxiety can impair an individual's goal-directed attention and behaviour by decreasing attentional control and increasing attention to threat-biased stimuli (Attentional Control Theory [ACT]; Eysenck, Derakshan, Santos, & Calvo, 2007). In particular, it is thought that anxiety mainly affects the central executive processes of attentional control, namely inhibition (i.e., using attentional control to restrain attention being directed to task-irrelevant stimuli and responses), shifting (i.e., using attentional control in a positive way to respond optimally to changing task requirements) and updating (i.e., monitoring and refreshing the working memory with the most up to date information), with the impact on

attentional control being greatest when threat is highest (Eysenck, Payne, & Derakshan, 2005; Friedman & Miyake, 2004).

A bias for the processing of threat-related stimuli has been described as a robust phenomenon which has been found in anxious adults and children (review by Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). Threat-related bias refers to an information processing bias where individuals are more likely to orient to threat in the environment and interpret ambiguous stimuli as threatening.

Musch and Broder (1999) argued that interference models, such as PET and ACT, cannot account fully for the negative impact of anxiety on exam performance. The interference model posits that anxiety interferes with cognitive processing during the test taking situation. However, research on interventions which focus purely on reducing anxiety levels are not always effective in improving exam performance. Some researchers have proposed a deficit model which argues that poor performance in highly test-anxious individuals results, at least in part, from a poor grasp of the subject knowledge coupled with a meta-cognitive awareness of that knowledge deficit. As Musch and Broder (1999, p. 106) summarise, "Test anxiety does not cause poor performance; rather, the reverse is true: test anxiety is merely an emotional reaction that accompanies the awareness of being inadequately prepared for the test." In other words, increased anxiety is a result of some awareness of failure, but not a cause of it.

Consistent with this proposition, Ashcraft and colleagues developed a theoretical framework to understand the impact of maths anxiety on mathematics performance. This framework suggests that maths performance decreases in maths-anxious individuals via a number of affective and cognitive factors that impact motivation. The authors first suggest, like Eysenck and colleagues, that maths anxiety induces worrisome thoughts and self-doubts which overload the working memory resources needed to undertake complex mathematical operations (which often involve multiple step computations, sequencing and mentally retrieving formulas). The authors further suggest that maths anxiety can lead to avoidance of learning new constructs, perhaps resulting from a fear of negative evaluation. The decline in maths performance caused by anxiety is labelled by the authors an *affective drop* (Ashcraft, Krause, & Hopko, 2007; Ashcraft & Moore, 2009). Studies have employed regression analysis techniques to establish causality, leading some researchers to suggest that test anxiety can impact

on working memory capacity, but can also be a reaction to a recognised difficulty (Gass & Curiel, 2011).

Recent studies have considered the role of working memory in understanding individual differences in achievement. Working memory is a multi-component system responsible for temporarily storing and maintaining information during complex cognitive operations. It is thought to consist of a central executive component which co-ordinates the phonological loop and visuo-spatial sketchpad (which are responsible for manipulation and short-term storage of verbal and visual/spatial information respectively; Baddeley & Hitch, 1994; Baddeley, 2001). Researchers sometimes break working memory down into verbal or spatial working memory, referring to the roles played by the phonological loop and visuo-spatial sketchpad components. Working memory has been found to be strongly linked with children's achievement on UK National Curriculum tests in English and mathematics (Gathercole, Pickering, Knight, & Stegmann, 2004). Consistent with PET and ACT, a large body of research has found that anxious children and adults with high working memory perform faster and more accurately on cognitively demanding tasks and therefore may be protected to some extent from the disruption anxiety has on academic performance. Individuals with low working memory capacity are therefore thought to be the most vulnerable to anxiety's negative impact on school performance (Ashcraft & Kirk, 2001; Miller & Bichsel, 2004; Hadwin, Brogan, & Stevenson, 2005; Owens, Stevenson, Norgate, & Hadwin, 2008; Johnson & Gronlund, 2009; Owens, Stevenson, Hadwin, & Norgate, 2012a). There is, however, an alternative view that anxiety may affect the academic performance of individuals with high working memory more so than those with low working memory. This is, it is proposed, because students with high working memory tend to use learning strategies which rely heavily on working memory and are therefore more susceptible to cognitive failures, whereas individuals with low working memory may make use of other learning strategies, such as shortcuts or heuristics, given that their working memory is low (Ramirez, Gunderson, Levine, & Beilock, 2013).

Interruption to attentional control aspects of working memory are likely to impact on academic performance because, to succeed academically, an individual needs to be able to avoid distraction in order to pay attention to their teachers and complete learning tasks such as revision, homework and exams (Parks-Stamm, Gollwitzer, & Oettingen, 2010). Smallwood and colleagues (2007) refer to education as "a dynamic interchange

between the internal and external worlds" where mind wandering (i.e., engaging in thoughts unrelated to the task in hand) impacts upon an individual's awareness of the external world. It has been proposed that mind wandering impairs the identification of stimuli in the environment, the encoding of information from that stimulus, and model building which integrates the information presented with background information that a person holds, allowing for meaning or comprehension of a stimulus, such as text, to be established (Smallwood, Fishman, & Schooler, 2007, p. 230).

McVay and Kane (2012) suggest that the executive control mechanisms associated with working memory may not only suppress task-unrelated thoughts when tasks demand concentration but, at other times, when executive control is not engaged by a task, support task-unrelated thought. In other words, executive control may be employed for both on- and off-task thinking. Given the important role working memory and attentional control play in maintaining on-task thoughts, it follows that anxiety's impact on these resources may also lead to lapses of task-unrelated thinking, which might in turn impact on achievement in school.

Aims of the Literature Review

This review aims to synthesise the literature to date to investigate the relationship between anxiety, attention, working memory and academic performance. Its objective is to understand how elevated anxious affect can impact on cognitive variables (related to attention and working memory) and academic performance in adults and children with anxiety.

Method

Data Sources

Systematic searches were conducted in four electronic databases: PsycINFO via EBSCO (1887 - 2014) (n = 44); Web of Science via Web of Knowledge (1950 - 2013) (n = 171); BIOSIS Citation Index via Web of Knowledge (1956 - 2014) (n = 3); Medline via Web of Knowledge (1950 – 2014) (n = 18). The search terms used were related to anxiety, attention or working memory, and academic achievement (see Appendix A for further details). The search terms included a list of keywords generated by the author using the thesaurus function on the PsycINFO database and from those identified in key papers found during the literature search. The final number of papers included in the review totalled 25.

Inclusion and Exclusion Criteria

Database searches generated a total of 236 records. Papers were included if they were articles published in peer reviewed journals in English. Studies were excluded if they did not measure anxiety and attention or working memory with academic achievement as an outcome. Review papers, brief reports, intervention studies or duplicates were also excluded from the analysis. See Appendix B for a flow chart showing at what stage papers were excluded and Appendix C for a list of reasons why papers were excluded after reading the full text.

Participants

Studies were included if participants were typically developing children or adults. Studies were excluded if the participants had any organic medical difficulties, such as epilepsy; or a pervasive developmental disorder, such as Autistic Spectrum Disorder (ASD). Studies which made it clear that participants had a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) were also excluded due to the possible effects of medication on the results.

Study Design

Studies were eligible for inclusion if they used quantitative correlational or factorial designs. Intervention studies were excluded from the review due to issues of construct validity (i.e., the construct variable may not have been reliably measured, leading to potentially unreliable conclusions in such studies). Case studies were also excluded.

Publication Requirements

Unpublished work such as dissertations and presentations at conferences were not included.

Results

Definitions of Attention and Working Memory

As mentioned above, several studies have suggested that anxiety impacts on academic performance via its negative effect on attention and working memory. In this review of the literature, attention and working memory are conceptualised as memory (short term and working memory), and attention control (sustained and divided attention, inattention, distractibility, mind wandering, task switching, vigilance, focusing and concentration). Although there are several terms used in the literature for inattention, the author conceptualises them all as engaging in thoughts unrelated to the task in hand rather than focusing on that task or goal.

Anxiety and Working Memory

To understand why academic performance might be influenced by anxiety, researchers have considered the role of working memory in the relationship between anxiety and academic performance. Chen & Chang (2009) found that students with higher foreign language anxiety also experienced a higher cognitive load, which they define as the total amount of mental activity performed by the working memory at any point in time. Consistent with ACT (Eysenck, Derakshan, Santos, & Calvo, 2007), foreign language anxiety and cognitive load were negatively correlated with listening comprehension academic task performance.

Some research suggests that different aspects of working memory may impact on academic performance and that their impact may differ at various stages of development. For example, Aronen and colleagues (2005) found that auditory working memory errors were significantly related to teacher-reported academic performance for all age groups (6-8 years, 9-10 years and 11-12 years). However, the relationship between academic performance and scores on the visual working memory task were different for different age groups. While 6-8 year olds' academic performance was significantly associated with their visual working memory, 9-10 year olds and 11-12 year olds' academic performance was only related to their auditory working memory, not their visual working memory. Performance on visual, not auditory tasks was significantly correlated with anxiety/depression for 6-8 year olds but not 9-10 year olds nor 11-12 year olds (Aronen, Vuontela, Steenari, Salmi, & Carlson, 2005).

Owens and colleagues (2008) have broken down working memory into verbal and spatial elements. They found that verbal working memory was positively associated with every standardised academic performance measure they used in children aged 11-12. Conversely, spatial working memory was only marginally associated with non-verbal reasoning. Trait anxiety was also marginally associated with verbal working memory, but not with spatial working memory. Significant indirect effects were found between trait anxiety and maths, quantitative reasoning and non-verbal reasoning, via verbal working memory. In other words, verbal working memory partially mediated the relationship between trait anxiety and academic performance (composite), explaining 50% of this relationship. When subjects were considered separately, verbal working memory explained an average of 51% of the variance of the initial relationship between trait anxiety and academic performance, whereas spatial working memory only accounted for an average of 8.63% of the variance. The differences between the percentages for verbal and spatial working memory were significant for all six academic performance measures, indicating that verbal working memory was a significantly stronger mediator than spatial working memory in the relationship between anxiety and achievement (Owens et al., 2008).

Later, the same authors separated working memory into central executive processes, phonological loop and visuo-spatial sketchpad in accordance with Baddeley and Hitch's (1994) model of working memory. Owens and colleagues (2012) tested these separate components of working memory using subtests of two standardised working memory measures, grouping children's performance on the various subtests which tap into each of these components. They found that worry was negatively correlated with academic performance and that this association was explained via central executive processes. Academic performance was significantly associated with both the central executive and phonological loop/visual spatial working memory. There was no evidence that the phonological loop/visuo-spatial working memory acted as a mediator in the relationship between anxiety and academic performance. The effect on academic performance was larger for central executive processes of working memory than for phonological loop/visuo-spatial working memory tests. While all aspects of working memory were associated with better academic test performance, the effect was larger for central executive processes ($R^2 = 0.66$, $p < 0.01$) when compared with phonological loop/visuo-spatial tests ($R^2 = 0.50$, $p < 0.01$). This research further

indicated that anxiety and depression were associated with increased worry about test-taking which interferes with complex working memory, leading to lowered test performance (Owens, Stevenson, Hadwin, & Norgate, 2012).

Conversely, some recent research suggests that children with high working memory may be unable to recruit their cognitive resources in order to achieve academically. Ramirez and colleagues (2013) measured maths anxiety in 154 children aged 5-7 years using a self-report maths anxiety measure. They found that while maths anxiety and working memory were not correlated overall, when individual differences in working memory used to split the sample into high and low groups they found that those with higher working memory were subject to pronounced negative relations between maths anxiety and maths achievement which were not found in participants with low working memory. Furthermore, when the authors split the results of maths achievement into achievement on easy questions (placing low demand on working memory) and achievement on hard questions (placing higher demand on working memory), they found a significant working memory × maths anxiety interaction for those with high working memory which was not found in those with low working memory. They label this the *choking effect* (Ramirez, Gunderson, Levine, & Beilock, 2013).

Vukovic et al. (2013) replicated this finding with young children with some, but not all, types of mathematical problem solving. In their longitudinal analysis, they found a significant effect of second grade (age 7-8 years) maths anxiety only for third grade (age 8-9 years) mathematical applications (problem solving using mathematic reasoning) as opposed to straightforward arithmetic problems, and only in children with higher working memory as opposed to lower working memory. They suggest that this is because mathematical applications, unlike arithmetic problems, can be less noticeably right or wrong. Vukovic and colleagues posit that the choking effect impacts on high and low working memory children equally, but that when learning problem solving in mathematics, only low working memory children remain able to benefit from instruction. Thus, this paper suggests that only learning performance generally, rather than maths performance in the moment, is influenced by maths anxiety in high working memory students (Vukovic, Kieffer, Bailey, & Harari, 2013).

Working memory and anxiety are therefore both shown to be related to academic achievement, with some research finding that working memory meditates the link

between anxiety and achievement. The majority of the research presented suggests, in line with PET (Eysenck & Calvo, 1992) and ACT (Eysenck et al., 2007), that anxious children and adults with low working memory capacity perform worse in academic tasks and those with high working memory have greater cognitive resources with which to cope with the disruption in working memory that anxiety may cause. Ramirez and colleagues found that children with high working memory performed worse than those with low working memory and Vukovic and colleagues argue that this is only with particular mathematics problems, perhaps those less noticeably right or wrong. They argue that children with high working memory tend not to employ strategies to cope under high cognitive load, such as finger counting, unlike children with low working memory. Although these findings do not support ACT, this may be because the specific mathematics tasks in these studies placed demands on aspects of working memory in a different way to those more general academic tasks used to measure academic performance in other studies.

Working Memory and Inattention

Working memory has been linked to indices of attention, such as distractibility, attention hyperactivity disorders and self-regulation. As discussed, Owens and colleagues (2012) found that only the central executive processes of working memory were found to mediate the relationship between anxiety and academic performance. Central executive processes have been highlighted in ACT as being implicated in attention control (Eysenck et al., 2007). This is supported by findings from Aronen and colleagues (2005), who found, in 66 school children, that a high number of errors on both auditory and visual working memory tasks was significantly associated with a high score on the 'attention problems' subscale of a teacher-report measure, even when age, gender and task load were controlled. Parks-Stamm and colleagues (2010) explored the role of distractibility in the association between anxiety, working memory and academic performance by teaching students with high and low levels of anxiety strategies for avoiding distraction and measuring their performance on a maths exam which drew heavily on working memory resources. During the exam, participants were presented with distractions. The authors posit that working memory is implicated in students' ability to use strategies for avoiding distractions during the exam. They found that as test anxiety increased, the effectiveness of distraction-ignoring strategies (temptation-inhibiting) increased. However, for students who were highly text anxious, using

strategies for focusing their attention (task-facilitating) impaired their exam performance. Using regression analyses, they found that temptation-inhibiting strategies for avoiding distractions were more successful than task-facilitating strategies for maintaining task focus and suggested that this was because temptation-inhibiting strategies reduced the demand on working memory by automating the strategy's implementation when the distraction occurs. However, they found this with undergraduate students using an anxiety measure with only five items (Parks-Stamm, Gollwitzer, & Oettingen, 2010).

Attention has therefore been shown to be associated closely with working memory and this relationship may implicate that central executive, which is known for its role in focusing attention and ignoring distractions. These aspects of cognition have also been conceptualised as self-regulation.

The Role of Self-Regulation

Buckner, Mezzacappa and Beardslee (2009) explored the role of self-regulation in the relationship between anxiety and academic performance. Self-regulation in this study was conceptualised as motivation, executive attention and inhibitory control. The sample included 155 8-18 year olds. Self-regulation was measured by the experimenter using questions from two 'Q-sort' measures (California Child Q-sort and Haan Q-sort; Block & Block, 1980 and Haan 1982 respectively), where personality traits are sorted into which are most like and which are least like the child, which gives a total scaled score. However, the experimenter had only met each child with their parent while conducting other measures during the course of the experiment. The results of regression analyses showed that young people with good self-regulation had much better indices of academic achievement (as measured by the standardised Wechsler Individual Achievement Test Screener; Psychological Corporation, 1992) and anxiety than their counterparts with more diminished self-regulatory capacities.

Bucker and colleagues (2009) further reported that the strength of the negative association between anxiety and self-regulation was moderated by age, being strongest for older (maximum age 18) compared with younger (minimum age 8) children. When adjusted for age, non-verbal intelligence (as measured by the matrices on Kaufman's Brief Intelligence Test; Kaufman & Kaufman, 1990), negative life events, chronic strains and life support networks, self-regulation continued to significantly predict

anxiety and average academic performance in all high school classes. Furthermore, self-regulation also significantly predicted whether or not children had ever been suspended (temporarily excluded) from school.

It should be noted that the American sample used in this study was unusual in that they were of extremely low socio-economic status with 40% having experienced homelessness, which may reduce generalizability. Furthermore, because self-regulation was conceptualised by Buckner and colleagues as a combination of variables, it is difficult to ascertain which might be more important for predicting academic performance. Similarly, other studies in this review measure inattention and hyperactivity as one construct. This is because often these two symptoms can be found together, most notably in the diagnosis criteria for ADHD. This raises questions around whether it is inattention, per se, which leads to impaired academic performance rather than hyperactivity and therefore represents a limitation of these studies. Research which explores the aspects of attention separately from other constructs may make it clearer how anxiety and attention interact to impair academic performance.

Achievement and Attention/Hyperactivity

Addressing this issue, Carroll, Maughan, Goodman and Meltzer's (2005) large scale UK study with over 10,000 children supports the finding that inattention, as opposed to hyperactivity, significantly mediates the link between ADHD symptomology and literacy difficulties. Similarly, Kempe and colleagues (2011) grouped participants by whether or not they had reading difficulties and measured their symptoms of ADHD at age 6-7, 7-8 and 8-9 years. They found a main effect of group (reading difficulties or no reading difficulties) for teacher and parent ratings of inattention, but not hyperactivity.

Barriga et al. (2002) ran multiple simultaneous regression analyses using both inattention and hyperactivity subscales as predictors for achievement on reading, spelling and arithmetic tests and teacher rated academic performance. Teacher rated academic performance was significantly predicted by inattention, but not by the hyperactivity subscale. When combined, inattention/hyperactivity significantly predicted scores on standardised measures of reading, spelling and arithmetic. However, when inattention and hyperactivity were considered separately, the inattention

subscale predicted academic performance on the three areas more strongly than hyperactivity (although these links no longer reached statistical significance).

Anxiety, Inattention and Academic Performance

Further studies have explored the extent to which attention difficulties and anxiety impact academic performance. Keogh, Bond, French, Richards and Davis (2004) investigated worry, the cognitive component of anxiety, and undergraduate students' proneness to be distracted by threatening and non-threatening, examination-relevant and irrelevant material. They created a distraction index depending on whether a distractor was present or absent and used reaction times on a computer task to measure distractibility. They found a significant main effect of presence/absence of a distractor and an interaction between worry and distractor. Threat words were more distracting than non-threat words for those in the high and medium worry groups. The low worry group, on the other hand, were equally distracted by threatening and non-threatening words. Furthermore, susceptibility to distraction from threatening and non-threatening words was negatively associated with exam performance. This indicates that anxious individuals are more susceptible to distraction from threat and therefore vulnerable to poor exam performance.

Using stepwise hierarchical regression, Durbrow, Schaefer and Jimerson (2000) found that teacher-reported anxiety, attention (both measured by the Revised Behaviour Problem Checklist) and learning-related behaviours (e.g., motivation, attitude towards learning) explained 32% (of the exam score) to 35% (of academic grades) of the variance in academic performance in children. In contrast, home background (e.g., affluence, experiences, caregiver involvement) and non-verbal cognitive ability (measured using Raven's matrices) account for only 11% (academic grades) to 14% (exams) and 6% (academic grades) to 22% (exams), respectively. Because constructs were grouped together for analysis, however, it is not possible to explore the contribution of anxiety, attention or cognitive ability separately. Comparing the relative strength of associations with academic performance of anxiety and attention, Durbrow et al. (2000) found that teacher-reported attention correlated with academic grades (0.64, $p < 0.001$) and exams (0.65, $p < 0.001$) only slightly less strongly than anxiety correlated with academic grades (0.54, $p < 0.001$) and exams (0.56, $p < 0.001$). It should be noted that the population used in this study were from children in a remote Caribbean community whose anxiety and inattention scores were found to be higher than average compared to average scores in North America.

Other research, however, suggests that anxiety and inattention may impact on specific aspects of academic performance in different ways. Pesenti-Gritti, Scaini, D'ippolito, Fagnani and Battaglia (2011) found that parent-rated inattention/hyperactivity and anxiety were both highly significantly associated with school performance in 398 twin pairs aged 8-17 years. However, after implementing multiple regressions to explore the relationships between emotional and behavioural variables (such as anxiety and attention deficit/hyperactivity) with performance in the domains of school, social and hobbies, they found that inattention/hyperactivity only predicted school performance, and anxiety symptoms only predicted social performance (i.e., number of friends, membership of clubs).

Comparing the strength of association of anxiety and attention specifically with academic performance, Hinshaw et al. (1987)'s study measured anxiety and attention in a sample of 579 children aged 5-6 years. Attention was measured using criteria for attention hyperactivity disorders from the DSM, including items on children's inattention, hyperactivity, impulsivity, peer interaction and popularity, as rated by parents and teachers separately. Anxiety/withdrawal was found to be significantly correlated with the inattention subscale. However, attention problems were found to be a better predictor of academic performance in all areas than was anxiety/withdrawal, which predicted only the sounds and letters aspect of academic performance, as opposed to maths and word reading.

Other studies also suggest that anxiety and inattention impact different specific aspects of academic performance in different ways. Using a longitudinal design, Romano et al. (2010) investigated the predictors of academic performance on a large regional data set (n = 1,521) when they were aged 5-6 years, 6-7 years, then 8-9 years. Mother-reported inattention (e.g., has difficulty concentrating) aged 6-7 was a significant predictor of maths aged 8-9 for boys. In a separate statistical model, where academic skills at age 6-7 were controlled, attention continued to be a significant predictor of reading and maths at age 8-9 years, whereas anxiety/depression was a significant predictor of reading at age 8-9, but not maths.

Also using a longitudinal design to analyse the predictive power of anxiety and attention in reading and maths, Grills-Taquechel and colleagues (2013), found that 6-8 year olds' inattention measured mid-year significantly correlated negatively with concurrent and end of year calculation as well as some aspects of reading (passage

comprehension and reading fluency), but not basic reading (a composite score of letter-word identification and decoding ability). Conversely, anxiety did not account for a significant proportion of the variance in any of the achievement outcomes longitudinally, suggesting that inattention played a bigger role than anxiety in these aspects of achievement. This finding is in line with West and Sadoski's study, where although anxiety was significantly negatively linked to self-report concentration in a sample of 106 medical students as measured using the Learning and Study Strategies Inventory, concentration was more strongly associated with measures of academic performance than anxiety (West & Sadoski, 2011).

Kempe et al. (2011) used a longitudinal design and found no significant main effect or interactions with reading ability and anxiety/depression in children between the ages of 6 and 8. Their only consistent findings were between reading and teacher- and parent-rated inattention. Similarly, Barriga and colleagues (2002) explored the association between anxiety/depression, attention problems and academic achievement in 58 young people aged 11-19 years and found that attention problems, as rated by an experimenter while children completed a computer task according to how much they were out of their seat, off-task, fidgeting and vocalising in every 15 second interval, were significantly associated with standardised achievement tests in reading, spelling, arithmetic and teacher-reported general academic performance. Anxiety, on the other hand, was not significantly associated with any aspects of academic performance (reading, spelling and arithmetic as measured using the standardised Wide Range Achievement Test).

Statistical Models

Some researchers have used hierarchical statistical analysis to further understand the contribution of attention and anxiety to academic achievement. Rabiner, Murray, Schmid and Malone (2004) used multilevel statistical modelling to analyse the associations between a range of variables in a sample of 621 children aged 6-7 years. Similarly to Barriga et al. (2002), they found that only being inattentive (i.e., having symptoms of inattention without hyperactivity) was independently associated with diminished academic achievement, whereas being anxious/shy did not significantly predict academic achievement. However, the academic achievement measure was a short (5-item) teacher report of their impressions of general academic performance.

According to research with a large sample of children in the UK by Carroll et al. (2005), children with higher separation anxiety and generalised anxiety scores were 2.15 times more likely to have literacy difficulties even when inattention was controlled for. Together, parent- and teacher-rated inattention accounted for significant variance in literacy scores, independent from anxiety. Therefore, although some researchers say that inattention is important in understanding the relationship between anxiety and academic performance, others suggest that they make independent contributions to achievement.

Considering the interaction between the different child-reported components of anxiety (physical symptoms, harm avoidance, social anxiety and separation anxiety) and inattention (measured using the inattention subscale from the DSM ADHD criteria), Grills-Taquechel et al. (2013) found in children aged 6-8 that concurrently, inattention mediated the harm avoidance (i.e., perfectionism and anxious coping) – academic achievement pathway. More specifically, greater harm avoidance was associated with better attention, which was associated with better reading and calculation scores. This suggests that harm avoidance acted as a motivator for children to perform academically. Similarly, their longitudinal analyses found that, although mid-year inattention considered on its own predicted impaired comprehension, fluency and calculation performance, it was found to actually improve reading fluency via its interaction with harm avoidance. Greater levels of harm avoidance predicted improved fluency for more attentive children, whereas fluency was impaired in those who were less attentive. In addition, separation anxiety was associated with decreased reading fluency for more attentive children compared with inattentive students, whose reading fluency showed little change, regardless of anxiety (Grills-Taquechel, Fletcher, Vaughn, Denton & Taylor, 2013).

While these interactions are small and in need of replication, they suggest that anxiety (harm avoidance) may actually improve attention, which improves academic achievement. In some areas of academic performance (reading fluency), more attentive children may benefit from aspects of anxiety (harm avoidance) but do worse with others (separation anxiety). This does not fit with findings from previous studies that suggest that anxiety is detrimental for academic performance overall.

A further study used structural statistical modelling to investigate the hypothetical pathways between teacher-reported anxiety/depression and academic performance in an

ethnically diverse sample of children aged 7-15 years. They measured 'internalising behaviours' (anxiety/depression and withdrawal), cognitive functioning (vigilance as measured by accuracy on a computerised visual search task and short term memory), classroom behaviour (e.g., completing work, motivation) and early academic achievement (maths, spelling and reading). Later, when these became available, the researchers took scores on the children's school achievement tests in reading, maths and language and created a composite scholastic achievement score. The best fit model for their data was labelled a dual pathway model, where anxiety/depression was found to have a significant indirect negative effect on academic achievement via cognitive functioning (i.e., memory and vigilance; $r = -0.18$, $p < 0.05$), although it should be noted that the indirect effect size is small. Expanding the model to take into account the children's early achievement tests in maths, spelling and reading did not significantly alter the general pattern of relations among the variables (Rapport, Denny, Chung, & Hustace, 2001).

Other Variables

No statistical models fully accounted for the variance in academic performance, and a number of other factors have been suggested to be associated with anxiety and academic performance. Smith, Arnkoff and Wright (1990) measured test anxiety, academic performance and other variables labelled 'cognitive attentional processes' (negative thoughts, underlying concerns, worry), 'social learning processes' (self-efficacy, outcomes expectations and goal-related motivation) and 'academic skills' (study habits and test taking skills) in 178 university students. Using hierarchical regressions to analyse their data, they found that negative thoughts, underlying concerns and worry emerged as more important in predicting academic performance and test anxiety than academic skills or social learning processes in predicting both academic performance and test anxiety. However, academic skills and social learning processes did still contribute significantly to academic achievement. This result suggests that even when children and young people are experiencing worry, their academic performance may still benefit from intervention focused on academic skills and social learning processes. In support, West & Sadoski (2011) found that time management skills and the use of self-testing learning strategies were generally stronger predictors of academic performance in medical students than anxiety, concentration or information processing abilities.

Szpunar, Khan and Schacter (2013) found that exposing undergraduates to frequent testing was associated with reduced occurrence of mind wandering (as measured by a self-report rating scale and thought probes) and increased note taking (as measured by the percentage of slides with additional notes added). The frequently tested group answered more questions correctly in their final test than the group who were given extra time to study instead of tests and the control group. They concluded, therefore, that it was the experience of tests rather than the associated increased exposure to the learning materials that reduced students' mind wandering and increased their note taking, ultimately improving their final exam performance. An additional benefit of this method of instruction was that test anxiety was found to be reduced for the final exam for the group who experienced frequent testing. Furthermore, the frequently tested group reported that the final exam was less cognitively demanding than the group who used the time to study more and the control group.

Discussion and Future Research

This review of the literature used a systematic search strategy to examine the links between anxiety, attention, working memory and academic performance. Consistent with attentional models of anxiety (e.g., ACT; Eysenck et al., 2007), there is increasing evidence within research to support the emergence of a theoretical framework that includes a role of attentional and working memory processes in explaining links between anxiety and academic achievement. For example, verbal working memory was found by Owens et al. (2008) to mediate the negative relationship between anxiety and academic performance in 11-12 year olds.

Extending these basic findings, further research has highlighted that different aspects of working memory may be more strongly associated with academic performance at different ages. For example, Aronen and colleagues' research suggested that different components of working memory may play more important roles at different stages of childhood. Their research suggests that children with better visual working memory achieved to a greater extent academically at age 6-8, but auditory working memory was more strongly associated with academic performance at age 9-12 (Aronen et al., 2005). As age increases, children are more frequently required to use spoken cues (for example during task instructions), rather than having their learning visually supported, which may be difficult for children with poor working memory as they struggle to process verbal information (Gathercole, Durling, Evans, Jeffcock &

Stone, 2008). If anxiety impacts on achievement via lowered verbal working memory skills, then it is possible that its effect becomes more evident across development, when young people rely more on verbal working memory capacity.

Extending this research, Owens et al. (2012) further found that the central executive aspect of working memory mediated the link between worry and academic performance. These findings are consistent with previous research (see Ashcraft & Krause, 2007) and lend support to ACT's proposition that worry interferes with the central executive. One possible explanation for this would be that attention to threat compromises working memory capacity via increased distractibility. For example, findings that anxious undergraduates were more distracted by threat words than non-anxious students (Keogh et al., 2004) suggest that anxiety may impact on attention by biasing it towards threat, as has been found previously (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). The extent to which working memory capacity is compromised with elevated anxiety via increased attention to threat is unclear.

This series of studies suggests that working memory acts as a buffer against poor academic performance (Eysenck et al., 2007). However, recent research has found that, in some circumstances, children aged 5-9 years who reported maths anxiety and who showed good working memory underperformed more in maths tasks which were complex, demanding on working memory and less noticeably right or wrong, compared to those with low working memory. Since these studies investigated the impact of working memory on these types of mathematical task specifically, it is unclear whether these findings apply to academic performance more generally and highlights the need for further research in this area.

Some research has examined the association between working memory and attention more broadly. The two studies in this review which examined both the variables of working memory and attention found that, as working memory increased, so did attention. Furthermore, this review highlights that inattention (i.e., symptoms linked to distractibility) predicted academic performance over and above behavioural symptoms including hyperactivity.

While some studies in the review found that anxiety and inattention were both correlated with academic performance, the majority found, using many different

measures of attention (e.g., parent/teacher-report, thought probes, computer tasks and using diagnostic criteria), that attention was more strongly associated with academic performance than anxiety, both in children (e.g., Grills-Taquechel et al., 2013) and in adults (e.g., West & Sadoski, 2011). The research further suggests that attention and anxiety may be associated more with performance in certain academic subjects than in others. For example, Romano et al. (2010) found, in children aged 8-9, that inattention significantly predicted achievement in reading and maths, whereas anxiety/depression predicted only reading achievement, not maths. Most studies included in this review agree that attention predicted all aspects of academic performance, whereas anxiety only predicted reading. (However, research by Grills-Taquechel et al., Kempe et al. and Barriga et al. showed that anxiety did not significantly predict academic performance at all.)

A growing body of research supports the proposition that anxiety interacts with cognitive processes to impact on performance of academic tasks. For example, Rapport and colleagues (2001) used statistical modelling and found that anxiety/depression reduced academic performance via memory/vigilance in 7-15 year olds. Although Rapport et al. measured memory/vigilance, not attention, vigilance and attention are both aspects of threat-bias, which Keogh et al. suggest impacts on academic performance in worried students.

Conversely, Rabiner et al. (2004) found that inattention (as measured by Conner's standardised Teacher-Ratings Scale) was independently associated with academic performance, but anxiety was not significantly associated with academic performance. However, these results should be interpreted with caution, as academic performance was only measured by a one-item five point teacher rating scale. This finding is slightly at odds with Carroll et al. (2005), who found that inattention and anxiety both made significant independent contributions to achievement in literacy (their only measure of academic performance).

Some aspects of anxiety have been shown to interact with attention to impact academic performance positively as well as negatively. Grills-Taquechel et al.'s findings suggested that, in reading fluency, more attentive children benefitted from harm avoidance (an aspect of anxiety) but were impaired in this academic area if experiencing high levels of separation anxiety. This is not congruent with findings from previous studies, which found that anxiety is detrimental for academic performance. It

may be that while some aspects of anxiety (e.g., harm avoidance) improve attention and therefore academic performance, others disrupt attention and impair it. This suggestion is consistent with ACT (which states that anxiety may recruit attentional control resources in conditions of high motivation; Eysenck & Derakshan, 2011) and with the literature that has found that anxiety improves test performance in pupils with higher working memory (e.g., Owens, Stevenson, Hadwin, & Norgate, 2012b). According to ACT, this improved performance may come at a cost to efficiency; that is, more anxious participants may make require more time or effort to carry out a task (Eysenck & Derakshan, 2011). However, no study included in this review measured task efficiency.

Future research should use anxiety measures which allow the impact of different aspects of anxiety on cognitive variables and academic performance to be analysed. It will also be important to analyse any impact by age and subject area. This is because there is some suggestion that different emotional and cognitive variables may interact and impact on varying academic areas for children of different ages; in some cases to improve rather than impair some areas of academic performance.

While the anxiety-academic achievement pathway may be influenced by other factors suggested by some studies, such as motivation and study skills, research needs to replicate these findings in large scale research with children and young people alongside attention and working memory variables in the future. Moreover, this research should be longitudinal, in order to understand the direction of relationships and how they may change over the course of a child's school career.

No studies show complete mediation between anxiety, attention, working memory and academic performance. Moreover, no studies entered anxiety, working memory and attention into a statistical model to investigate the contributions of each of these factors on academic performance. Future research should address this issue by measuring anxiety, attentional indices, working memory and academic performance in children and examining the relationships between them. This is to better understand the independent contributions of each cognitive variable on academic performance and whether these mediate the link between anxiety and achievement.

Limitations of Studies

Participant characteristics. Of the 26 studies included in the review, only four were from the UK. The majority (n = 16) were from North America, three were from

Europe (not including the UK), one was from Taiwan and one from the Caribbean. Of the North American studies which reported ethnicity, this ranged from 4 - 90% White. The results should therefore be generalised to a UK population with caution. Nine studies involved adults; the rest involved children where ages ranged from 2 to 18 years. It should be noted that measuring academic performance in children aged 7 and under may not be appropriate, since more formal education does not begin until this age in North America, where most of these studies were carried out. Some studies involving young children noted that their samples may be too young to show some certain academic difficulties, such as reading.

Measures. The wide variety of measures for anxiety, attention, working memory and academic performance used by studies in this review may contribute to the inconsistencies in findings. The operationalization of these variables in different measures may have led to studies tapping into slightly different constructs. For example, Grills-Taquechel et al. (2013) used the 39-item self-report Multidimensional Anxiety Scale for Children which measures physical symptoms (e.g., tense/restless), social anxiety (e.g., public performance fears), harm avoidance (e.g., perfectionism), and separation anxiety. In contrast, the Revised Children's Manifest Anxiety Scale, used by Buckner et al. (2009), separates anxiety into worry, defensiveness, physical symptoms and social anxiety. In addition, worry was measured using the worry subscale of the Children's Test Anxiety Scale (used by Owens et al., 2012a) and Revised Test Anxiety Scale (used by Keogh et al., 2004). While these measures have good reliability (α = 0.64-0.93, where reported) and allow for a more in-depth analysis of anxiety's impact on academic performance, comparisons between studies are more difficult.

Similarly, while some studies measured trait anxiety, others measured state anxiety (e.g., test anxiety), which could lead to different findings due to the different nature of these two constructs. Furthermore, some researchers have used or developed their own measures of anxiety for specific subject areas, such as achievement anxiety (used by Smith et al., 1990; α not reported); maths anxiety (used by Ramirez et al., 2013; $\alpha = 0.55$ and Vukovic et al., 2013; α not reported) and foreign language anxiety (used by Chen and Chang, 2009; $\alpha = 0.87$). Although helpful for understanding the impact of anxiety in different situations, this also makes it difficult to generalise the findings of these studies and compare the results.

While most studies use scales, one measure integrated clinical criteria for an anxiety or ADHD diagnosis. Pesenti-Gritti et al. (2011) grouped items of the parent-rated Child Behaviour Checklist, judged by at least 64% of clinicians as symptoms of psychiatric disorders, to create DSM-oriented subscales. Cronbach's alpha was not reported for this method, however, so it is not clear whether or not this style of measure was reliable within their sample.

Studies included in the review measured anxiety and inattention by asking the views of various informants, sometimes because children were deemed too young to self-report on these constructs. These may not reflect children's own internal experiences. Furthermore, previous research has found that teacher-, parent- and self-reports of anxiety do not always correlate (De Los Reyes & Kazdin, 2005), therefore caution needs to be used when comparing reports from different sources. Of the 18 studies which measured attention, 13 were parent/teacher-reports, two were self-reports, two used experimental computer tasks and one used an experimenter rating. While eight of the 15 measures used were standardised, others, including parent and teacher-reports, may be subject to bias.

A limitation of many of the studies is that variables were often grouped and measured together. In addition, certain standardised measures, such as the parent- and/or teacher- report Strengths and Difficulties Questionnaire (used by Carroll et al., 2005), Revised Behaviour Problem Checklist (adapted and used by Hinshaw et al., and Durbrow et al., 2000) and Child Behaviour Checklist (used by 10 of the 29 studies included in this review), include anxiety/depression and attention/hyperactivity subscales. This makes it difficult to understand the contribution of each construct separately.

Academic performance has been measured using standardised measures by 18 authors, using average grades by seven authors, using final exam results by seven authors and using parent/teacher-report by four authors (total is more than number of studies due to authors using more than one measure). While standardised tests are less subject to bias than parent/teacher-report, they may only capture performance at one point in time. Average grades and parent/teacher-report capture performance over time, with the benefit of not exposing participants to standardised tests and exams which may induce test or state anxiety, perhaps not accounted for, which could therefore impact the results. Future research should use standardised and average grade measures from

different time points to create composite scores for subjects which reflect performance as fairly as possible.

Limitations of the Review

The search terms used to find papers were chosen due to their relatedness in the literature to the constructs which have been focused on in this review. However the author may not have chosen terms which would have yielded relevant literature. In addition, articles were appraised and excluded according to the inclusion and exclusion criteria by the author alone which increases the risk of researcher bias. Future research should ensure that more than one researcher applies the search criteria to the literature and should measure inter-rater reliability.

There was a risk of publication bias in the review, since only studies from peer reviewed journals were included. This may have resulted in the inclusion of papers which found significant, rather than non-significant results. Including only articles written in English may have meant that relevant studies with more culturally diverse samples may have been missed. In addition, the exclusion of qualitative research may have restricted the depth of research included in this review.

Implications for Practice

Professionals working with young people should consider the interactive nature of anxiety, cognitive processes and academic performance. For example, individuals presenting attention difficulties may benefit from emotional support, from an Emotional Literacy Support Assistant (a teaching assistant with training in emotional support) or similar, if the cause of their difficulties could be anxiety. Some research included in this review suggests that individuals can be academically successful despite high levels of anxiety if their motivation or study strategies are effective. Adults in schools could support children and young people to develop these motivation styles and learning habits in order that students may do well academically even if other factors make them vulnerable to underachieving.

The studies reviewed indicate that anxiety which results from taking tests and exams does impact on performance in these tests, calling into question their usefulness for accurately measuring individuals' true capabilities. This has implications for schools and colleges in the UK, where a recent policy change will lead to an increase in examinations for academic assessment from 2015 (DfE, 2013). Schools should

consider running evidence based exam-stress groups or similar, where young people can learn to manage their anxiety and potentially reduce its impact on their results. Test anxiety's impact on cognition and academic performance has implications for psychological as well as academic testing, as the cognitive tests used by Educational Psychologists (EPs) may be just as anxiety provoking for some as taking an exam, and may lead to disruption of working memory and attention control therefore lowering the results of these and other subtests. It is important for EPs to be aware of the stress that cognitive testing may induce and consider alternative, less anxiety-provoking methods where possible (e.g., dynamic rather than standardised assessment). Where standardised cognitive tests are necessary, EPs should measure state anxiety and control for this when interpreting the results of cognitive tests in order to yield more accurate results.

Chapter 2: Empirical Paper

An Exploration of Anxiety, Attention, Working Memory and School Performance in Children

Academic performance is widely believed to predict to positive life outcomes for children and young people and, as such, the correlates of academic performance have received a great deal of attention from researchers. A meta-analysis of studies from a number of Western countries found that high school academic performance predicted adult education level and job success in adulthood (Strenze, 2007). Evidence from a growing number of researchers suggests that negative affect, including anxiety, depression and worry, is associated with impaired academic performance in children and young people from the UK and internationally (Hembree, 1988; Keogh, Bond, & Flaxman, 2006; Owens, Stevenson, Norgate, & Hadwin, 2008; Owens, Stevenson, Hadwin, & Norgate, 2012a).

Anxiety

According to the Diagnostic Statistical Manual (5th Edition [DSM-5]), anxiety disorders are characterised by excessive concern, threat or fear underpinned by characteristic cognitive ideation symptoms (e.g., worry), behaviour symptoms (e.g., avoidance) and physical symptoms (e.g., muscle tension; American Psychiatric Association [APA], 2013). A number of anxiety measures have been used to explore the impact of these subcomponents on academic performance in research with non-clinical populations, such as worry (Owens et al., 2008), physical symptoms (Mazzone et al., 2007) and harm avoidance (Grills-Taquechel, Fletcher, Vaughn, Denton, & Taylor, 2013). Furthermore, researchers have found that specific types of anxiety can impact academic performance in particular academic domains, such as test anxiety (Hembree, 1988; Keogh, Bond, French, Richards, & Davis, 2004), maths anxiety (Ashcraft & Krause, 2007) and foreign language anxiety (Horwitz, Horwitz, & Cope, 1986; Chen & Chang, 2009).

A meta-analysis found that around 10% of participants across studies aged 2-21 years met the criteria for an anxiety disorder (Costello, Egger, Copeland, Erkanli, & Angold, 2011) and one study has found that, of a group of individuals diagnosed with an anxiety disorder who dropped out of school early, 24% cited anxiety as the primary reason for leaving (Van Ameringen, Mancini, & Farvolden, 2003). Furthermore, research from the UK showed in 12-13 year olds that as trait anxiety increased, school

attendance significantly decreased (Richards & Hadwin, 2011). Understanding the cognitive and affective pathways between anxiety and academic achievement may increase our understanding of how professionals working with children and adolescents could identify and intervene when anxiety may be preventing young people from reaching their academic potential in schools and colleges.

Theoretical Background

A cognitive process implicated by theorists in the anxiety-academic performance pathway is working memory. Working memory is responsible for temporarily storing and maintaining the relevant information an individual needs to perform complex cognitive operations. It consists of a central executive which co-ordinates the phonological loop (for short-term manipulation and storage of speech-based information) and visuo-spatial sketchpad (for manipulation and storage of visual and spatial information) components (Baddeley & Hitch, 1994; Baddeley, 2001). Eysenck and Calvo's (1992) Processing Efficiency Theory (PET) proposes that anxiety and associated worry place a high demand on cognitive resources, with resulting task unrelated thoughts impairing the working memory by taking up space in its limited capacity. According to this theory, the impact of anxiety on academic performance may be two-fold: declines in both processing efficiency (the amount of effort used to perform on a task) and performance effectiveness (the quality of an individual's task performance).

Working memory forms part of a broader definition, linked to academic achievement and executive functioning. Focusing more on anxiety's effect on the central executive, the more recent Attentional Control Theory (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007), proposes that anxiety can impair an individual's goal-directed attention and behaviour by decreasing attentional control and increasing attention to threat-biased stimuli. According to this theory, anxiety interferes with the central executive processes of updating (i.e., apprising and monitoring the information currently within working memory), inhibition (i.e., restraining attention from being directed to task-irrelevant stimuli and responses), and shifting (i.e., using attentional control in a positive way to respond optimally to changing task requirements; Eysenck & Derakshan, 2011; Friedman & Miyake, 2004). Consistent with these theoretical frameworks, Johnson and Gronlund (2011) have highlighted that anxiety will maximally disrupt performance when the demands on working memory have overloaded the phonological loop, and when inhibition and switching of attention are required.

Working Memory and Academic Performance

Working memory is widely recognised to be associated with academic achievement. For example, research from the UK has found that working memory predicts English and maths at age 7, maths and science at age 14 and General Certificate of Education (GCSE) results (Gathercole, Pickering, Knight, & Stegmann, 2004; Grimleya & Banner, 2008). Many researchers have considered the role of working memory in anxiety's impact on school performance (e.g., Owens et al., 2008; 2012; Ng & Lee, 2010). In a review, Ashcraft and Moore (2009, p. 197) state that "the primary cognitive impact of math anxiety is on working memory", suggested to be due to worries and self-doubts placing load on the working memory resources needed for "multistep computations, sequencing of mental procedures, mental lookup of formulas and equations, and the like" (Ashcraft & Moore, 2009, p. 203). In support, Aronen and colleagues found that low working memory was associated with teacher-reported academic performance in children aged 6-13 years (Aronen, Vuontela, Steenari, Salmi, & Carlson, 2005). Importantly, research has increasingly recognised that verbal, rather than spatial working memory more strongly mediates the link between anxiety and academic performance (Owens et al., 2008; Meijer & Oostdam, 2007).

Anxiety, Mind wandering, Working Memory and Academic Performance

Consistent with the notion that anxiety impacts on cognitive processing, studies have found that anxious adults with better attentional control were more able to shift their attention away from threatening stimuli, implicating attentional control as a mediating factor in anxiety's impact on performance (Derryberry & Reed, 2002; Eysenck & Derakshan, 2011). Research has shown that individuals who experience clinical levels of anxiety may be less able to control negative intrusive thoughts (Ruscio & Borkovec, 2004). Moreover, mind wandering (i.e., subjective experience of task-unrelated thoughts [TUTs]) has been associated with low mood and dysphoria in adults (Smallwood & O'Connor, 2011; Smallwood, O'Connor, Sudbery & Obansawin, 2007). Kane et al. (2007) suggest that the relationship between low mood and mind wandering is reciprocal; inducing a low mood elicits mind wandering and mind wandering leads to a low mood. Indeed, some researchers have argued that "a wandering mind is an unhappy mind" (Killingsworth & Gilbert, 2010, Title).

Some researchers argue that that individuals with lower working memory capacity engage in more mind wandering because off-task thoughts represent an executive-control failure and are generated automatically. Working memory resources, it is proposed, are required to keep off-task thoughts out of our focus (McVay & Kane, 2009; 2010). Consistent with ACT (Eysenck et al., 2007), mind wandering has been found by researchers to be associated with cognitive failures (everyday lapses of memory and attention), decreased concentration on cognitively demanding tasks, increased variability in reaction time (RT) and has been shown to affect those with a lower working memory capacity more often than those with higher working memory capacity in conditions where participants have high cognitive load (Kane et al., 2007; McVay & Kane, 2009; 2012; Kane & McVay, 2012).

In contrast, Smallwood and Schooler (2006) found that off-task thoughts decreased during cognitively demanding activities, which suggests that the act of mind wandering draws on working memory and executive resources. In support of this notion, tasks which place high demands on working memory have been found to decrease mind wandering, which, some theorists argue, implicates working memory in the maintenance of TUTs (Levinson, Smallwood & Davidson, 2012).

There is growing support for the proposition that attentional control plays a role in achieving academically, as has been demonstrated by a number of researchers. Mind wandering has been thought to lead to decreased reading comprehension in a study tracking eye-movements (Reichle, Reineberg, & Schooler, 2010). Undergraduate students who have engaged more in mind wandering in a lecture were found to perform less well in exams (Lindquist & McClean, 2011). Furthermore, susceptibility to distraction has been found to mediate the relationship between test anxiety and exam performance in a group of undergraduate students (Keogh et al., 2004). Mind wandering was found to mediate performance on a measure of general aptitude, implying that the ability to avoid mind wandering could improve performance on such tests (Mrazek et al., 2012).

Aims of the Current Study

In previous research, McVay and Kane (2009) used a computerised go/no-go task, where participants were asked to press to respond to go (non-target) stimuli and inhibit responses to no-go (target) stimuli. Responses to target trials provide an indicator of an

individual's ability to maintain goal-directed attention. In their task, stimuli were semantic (e.g., go = animal words, no-go = food words), perceptual (go = lowercase words, no-go = uppercase words) or semantic-perceptual (go and no-go stimuli were words which differed on both dimensions). The task incorporated thought probes after a small number of no-go trials. This task was designed to measure mind wandering (i.e., engaging in TUTs) and other attentional variables (e.g., task accuracy, variability in RT) in adults. They found that, as working memory capacity increased, mind-wandering rates decreased. Furthermore, as participants' variation in RT increased during the task, indicating fluctuations in individuals' control of conscious thought, mind wandering and cognitive failures increased and working memory decreased.

Following McVay and Kane (2009), the current study measured variables associated with mind wandering using a go/no-go task with children, to understand the relationship between this construct and other attentional indices (self-report attention control, self-report cognitive failures), verbal working memory (listening recall, backwards digit recall), school performance (academic performance, attendance) and anxiety (self-report, teacher-report).

Smallwood, Fishman and Schooler (2007) argue that mind wandering is an under-recognised influence on educational performance and highlight the need for different domains of research to come together to investigate this issue. The current study aimed to address this suggestion by bringing together the affective factor of anxiety with the cognitive factors of working memory and attention in order to explore their influence on academic performance in a UK sample of children.

Hypotheses

Variables which indicate poor attention control, including mind wandering, were hypothesised to be positively associated with anxiety and negatively associated with verbal working memory and academic performance. As well as being positively associated with inattention, anxiety was further hypothesised to be negatively related to verbal working memory and school performance variables, including academic performance. Consistent with previous research (Ma, 1999), maths achievement was hypothesised to be more strongly associated with anxiety and verbal working memory than reading or writing, as this subject is thought to place greater demand on working memory resources.

Method

Participants

In order to recruit participants, schools were sent a brief information sheet through the University of Southampton Research in Partnership scheme (see Appendix D). One school agreed to become involved after four months of schools being approached. During this time the researcher had also recruited a second school outside of this scheme, but also within the South of England. In each school, letters which detailed the procedure, confidentiality and right to withdraw were sent to the parents of 147 children aged 9 to 10 years. Parental opt-in consent was gained for 28 children in one school (32.1% of the number approached at this school) and 9 in the second school (15% of the number approached at this school). Participants recruited were an on average aged 9.9 years, SD = 0.39 years, range = 9.42 to 10.83 years, 19 girls.

Power

Power was calculated using G*Power version 3.1.3 (Faul, Erdfelder, Lang & Buckner, 2007). Assuming that the current study would achieve an effect size at least as great as those of Owens and colleagues (2012, $R^2 = .30$) at least 27 participants were needed to carry out a linear regression analysis with 95% confidence interval and 5% significance level.

Design

This study used a within subjects design. The primary independent variable was self-report trait anxiety. Verbal working memory, mind wandering, RT variability on the go/no-go task, self-report cognitive failures and self-report attention control were mediator variables. The primary dependent variable was participants' academic performance. Gender and time of day of computer based assessments were also measured.

Measures

Negative Affect Variables

Self-report anxiety. The Revised Children's Manifest Anxiety Scale Second Edition (RCMAS-2; Reynolds & Richmond, 2008) assesses the level of general anxiety in young people with 49 dichotomous (yes/no) items. The reading level of this scale is that of an average 8 year old. Yes-responses were scored in the positive direction and

can be totalled to give an overall anxiety score from 0 to 49. There are four anxiety subscales: physiological anxiety, worry, social anxiety and defensiveness. The measure's inconsistent responding index allows for the identification of participants who have not responded accurately. Internal reliability has been found to be good, with Cronbach's alpha for total score found to be 0.92 (Reynolds & Richmond, 2008) and for all subscales and the total scale ($\alpha > .70$). Test-retest reliability has been found to be correlated at .96 (Reynolds & Richmond, 2008). In the current study, internal consistency was found to be good (total $\alpha = 0.9$, worry subscale $\alpha = 0.9$).

Teacher-report anxiety. The School Anxiety Scale-Teacher Report (SAS-TR; see Appendix E) is a 16 item questionnaire that assesses the anxiety of pupils aged 5-12 years (Lyneham, Street, Abbott, & Rapee, 2008). Each pupil's class teacher completed 16 questions on a four point scale: 0 = 'never', 3 = 'always' to generate an anxiety score from 0 to 48. There are two anxiety subscales: generalised anxiety and social anxiety. Cronbach's alphas have been shown to be good ($\alpha = 0.92$ for social anxiety and $\alpha = 0.90$ for generalised anxiety subscales), which indicates high internal reliability of the scale. Test-rest reliability was also shown to be acceptable after 8 weeks ($r = 0.73$; Lyneham, et al., 2008). Internal consistency in the current study was also found to be good ($\alpha = 0.9$ for the overall scale, $\alpha = 0.9$ for social anxiety and $\alpha = 0.8$ for generalised anxiety subscales).

Depression. The depression subscale (9 items) of the Revised Children's Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000; see Appendix F) was be used to measure depressive tendencies in subjects. One item was removed as it mentions death. Children rated items on a four point scale where 0 = 'never' and 3 = 'always' generating a score from 0 to 27. Reliability for the depression subscale of this measure has previously been found to be good ($\alpha = 0.78$; Chorpita et al., 2000). In the current study Cronbach's alpha for this subscale was also good ($\alpha = 0.8$).

Attentional Indices

Attention control. A child version of the Attention Control Scale (ACS; Derryberry & Reed, 2001; see Appendix G**)** was used to measure children's perception of their own attention difficulties, which has been shown to be negatively associated with anxiety ($r = -0.51$; Muris, Merckelbach, Ollendick, King, & Bogie, 2002). The

scale has 20 questions which measure the child's ability to focus and shift their attention. Responses are scored on a four point scale: 0 = 'never', 3 = 'always', making a total score from 0 to 60. Internal consistency has been found to be good for the total score, focus subscale and shifting subscale ($\alpha = 0.8$, $\alpha = 0.7$ and $\alpha = 0.7$ respectively; Muris, de Jong, & Engelen, 2004). Internal consistency for the current study was similarly good for overall scale, focus and shifting ($\alpha = 0.8$, $\alpha = 0.7$ and $\alpha = 0.7$ respectively).

Cognitive failures. The Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, Fitzgerald & Parkes, 1982) was adapted by the author of the current study for children and was used to measure children's mistakes with thinking day-to-day. The adapted measure included 22 items and responses were scored on a five point scale: 0 = 'never', 4 = 'very often', yielding a total score from 0 to 88. Some items not relevant for children were removed (such as "Do you leave important letters unanswered for days?" and "Do you find you forget which way to turn on a road you know well but rarely use?"), while others were adapted (for example, the item "Do you find you forget what you came to the shops to buy?" was replaced with "Do you find you forget what you came to the teacher to ask?"; see Appendix H for the original and Appendix I for the re-worded questionnaire). Internal consistency for the adapted measure in the present study was high ($\alpha = 0.9$).

Mind wandering. A number of variables related to mind wandering were measured using a go/no-go task on the computer, which was adapted by the experimenter from a task used in previous research with adults (McVay & Kane, 2009). During this task, in the current study, participants saw a series of arrows flash on the screen. Arrows were presented for 100 ms, with 300 ms between each stimulus. They were asked to press the left or right arrow keys on a response pad as quickly as possible for non-targets (arrows pointing left or right) and to withhold responses to targets (a double ended arrow). The children were also told to expect thought probes immediately following some targets with the question, "What were you just thinking about?" and three response options. This was designed to measure children's in the moment subjective experience. Participants were asked to report what they were thinking about just before the probe, and the experimenter explained these choices when introducing the task, which were (1) I was thinking about the task (on-task thoughts); (2) I was thinking about how well I was doing on the task (task-performance); (3) I was thinking

about other stuff, like worries, feelings, people (off-task thoughts/TUTs). Participants completed 10 non-analysed practice trials, following the instructions, which ended with a thought-probe, where subjects responded to by pressing the corresponding number key. Participants were given a break after each block totalling three breaks.

In order for this study to maintain the same ratio of go to no-go trials and probed to non-probed no-go trials as that in McVay and Kane's study, the total number of trials was 900 (in 4 blocks of 225), with 25 out of 225 in each block being no-go trials and 15 out of 25 no-go trials being thought probed. This yielded a total number of 60 thought probes from each child. The task took no more than 20 minutes to complete.

The go/no-go task used in this study was designed to measure task accuracy (mean accuracy rates for target [no-go] and non-target [go] trials); speed of responding (mean RT for go trials); attentional fluctuations (intra-individual RT variability); mind wandering overall and by block (% thought probe reports of TUTs); mindless responding (RTs for trials preceding target commission errors); and attentional lapses (RTs for trials preceding a task unrelated thought report).

Verbal Working Memory

Participants completed two measures of verbal working memory from the Automated Working Memory Assessment (AWMA; Alloway, 2007), which was designed for young people aged 4-22 years. The first measure was listening recall, where the child was presented with a series of spoken sentences, and verified the sentence by stating 'true' or 'false', and then recalled the final word for each sentence in sequence. This subtest generated two standardised scores: a memory score which indicated how many words were recalled and a processing score which indicated how many sentences were correctly classified as true or false. The second verbal working memory measure was backward digit recall, where the child was required to recall a sequence of spoken digits in reverse order. For children aged 4 to 7 years, test–retest reliability over a two week period was found to be .81 and .64 for listening recall and backward digit recall respectively (Alloway, Gathercole, Kirkwood, & Elliott, 2008). A verbal working memory composite score was calculated by adding scores from the listening recall and backwards digit tasks and dividing by two.

School Performance

Academic performance. Academic performance was measured using pupils' current National Curriculum (NC) levels from teacher assessment for reading, writing and mathematics. For validity, the current NC levels were entered into a correlation analysis with pupils' NC levels obtained during their end of Key Stage 1 (in school year 2; aged 6 – 7 years) SATs. SATs are tests which were, until recently, routinely administered to school children at the end of each Key Stage across all UK schools maintained by the local authority. This measure was chosen because it is standardised and externally examined, reducing the chance of teacher bias. NC levels are the unit of measurement of academic progress all children in the UK education system are given by their teachers based on non-standardised assessment. The preliminary sublevels of progress for each child are prefixed by P and range from 1-8, after which the main levels begin again at 1 and continue numerically. Each main level can be divided into three sublevels denoted by the letters A, B and C. For the current study, each NC sublevel has been numbered, including the preliminary levels (see Table 1). Since NC levels from KS1 SATs and current NC levels were significantly correlated (all $p < 0.01$), current NC levels were taken forward as measures of academic performance in subsequent analyses. To give an overall score of achievement, an academic composite score was also calculated by adding pupils' current NC levels in reading, writing and maths and dividing by three.

While NC levels have been treated as continuous data in the current study due to their ordered nature, it could be argued that the sublevels of progress represent categorical rather than continuous data. This should therefore be noted when interpreting the validity of the results of regression analyses in this study using NC level data as the dependent variable. Other studies have dealt with this issue by administering an academic test battery, such as the Wide Range Achievement Test, or by using raw scores from school-based assessment. The range of assessments used to inform pupils' NC levels in each academic area across the two schools involved made comparing pupils' raw scores challenging. Furthermore, although alternative measures of academic performance were considered, NC levels routinely measured by schools we chosen to reduce the demand placed on the schools and young people involved in the study.

Attendance. Attendance data was obtained from schools as a percentage of half day sessions attended that academic year. This is how schools are required to collect pupil attendance data by the DfE.

Procedure

Participants were recruited and consent gained from parents (see Appendix J). Children were collected in groups of 6 - 8 and taken to a quiet room in school. A child information sheet (see Appendix K) was read aloud and the procedure was explained fully to children so that informed consent could be sought. Following this, the experimenter read aloud the questionnaires and answered any questions to ensure that the children understood what was being asked of them. The children completed questionnaire measures of trait anxiety, depression, cognitive failures and attentional control. Questionnaires had participant numbers on them instead of names for anonymity. The measures were counterbalanced across groups. Children were seated some distance away from each other to allow for privacy and were reminded to be honest and that there were no right or wrong answers. The experimenter then took children individually to administer the computerised measures of working memory and the go/no-go task, again in a quiet room in school. Class teachers were given a teacher-report school anxiety questionnaire to complete for each child who participated, which were collected at the end of the day. Data on the children's academic performance and attendance was also gained from the Special Educational Needs Co-ordinator from each school at this time.

Ethics

Ethical approval was gained for this study from the University's Psychology Ethics committee and the Research Governance Office (see Appendix L). Head teachers were approached regarding the study and subsequently information letters were sent to parents/guardians asking for consent for their child to participate in the study. Pupils also gave their informed consent to participate by signing a consent form on the day they completed their questionnaires. Children were debriefed by the experimenter and given an information sheet and certificate to take home. The children were also given a £5 high street voucher, or this was given to their class teacher to buy wet play games. This was to thank the children for their hard work and commitment to the study.

Table 1:
Denotations of National Curriculum (Academic Performance) Levels

NC level	Denotation
Preliminary levels	
P1	1
P2	2
P3	3
P4	4
P5	5
P6	6
P7	7
P8	8
NC levels	
1C	9
1B	10
1A	11
2C	12
2B	13
2A	14
3C	15
3B	16
3A	17
4C	18
4B	19
4A	20
5C	21
5B	22
5A	23

Data Analysis

Following ethical approval, the data were entered into the statistical software package IBM SPSS Statistics (version 21), where participants were identifiable only by participant numbers. The data were handled in accordance with the Data Protection Act and the University's ethical guidance before, during and after analysis.

The inconsistent responding index of the RCMAS indicated that one participant's anxiety data may not be valid and therefore their complete data set was removed from

the analysis. A second participant was removed from the analysis due to having not completed the mind wandering experimental task. A third participant's data were excluded from the analysis as their working memory scores were two standard deviations away from the norm. The total number of participants included in the analyses totalled 34.

Results

Parametric assumptions were tested for all the data, and attendance, reading, TUT rate and total teacher-report anxiety scores were found to be non-normally distributed, $D(33) = 1.58, 1.52, 1.48, 1.44$ respectively (all $p < .03$). Non-parametric analyses were therefore carried out on these variables. Means, standard deviations and range for negative affect, attentional indices, verbal working memory and school performance variables are shown in Table 2.

Table 2:
Means, Standard Deviations and Range for Negative Affect, Attentional, Verbal Working Memory and School Performance Variables (n = 34)

Variables	Mean	SD	Range
Negative affect			
1 Self-report anxiety	15.06	9.42	2-38
2 Self-report worry	6.76	4.27	0-15
3 Teacher-report anxiety	5.74	6.10	0-26
Attentional indices			
4 Attention control scale	28.06	9.83	11-55
5 Cognitive failures	36.88	16.92	10-82
6 TUT rate (%)	21.86	19.92	0-66.67
7 RT Variation	137.82	36.29	73.6-228.9
Verbal working memory			
8 Listening recall	108.41	14.38	82-141
9 Backwards digit	106.27	15.47	77-137
School performance			
10 Reading	18.35	2.26	12-21
11 Writing	17.26	2.14	12-21
12 Maths	18.32	2.23	13-22
13 Academic composite	17.98	2.04	13-21
14 Attendance (%)	98.05	3.16	88.3-100

Self-report anxiety can be converted to a standardised T score, where the mean of the norm sample T = 50. Pupils with T scores > 60, falling at least one standard deviation above the mean, are thought to be of clinical interest. In the current study, 7 pupils reached this level (20.6%). For the worry subscale, 9 pupils (26.5%) had T scores which indicated clinically elevated levels. A one-way Analysis of Variance (ANOVA) showed that, as has been found previously, girls scored significantly higher on self-report anxiety than boys, $F(1, 32) = 6.38$, $p < .05$.

Scores on the working memory indices were standardised and can be grouped into high (one or more standard deviations above the mean), average and low (one or more standard deviations below the mean). Scores would indicate that pupils in this sample had higher scores than the age matched norms for listening recall (low $n = 1$ [2.9%]; average $n = 22$ [64.7%]; high $n = 11$ [32.4 %]) and backwards digit (low $n = 3$ [8.8%]; average $n = 21$ [61.87%]; high $n = 10$ [29.4 %]). It should be noted that one pupil was removed from original the sample due to working memory scores which were more than two standard deviations below the mean.

Regarding NC levels, an indicator of academic performance, the DfE expects that the average child will achieve level 2, denoted in the current study as 12-14, at Key Stage 1 SATs. In the current study, pupils on average did achieve level 2 (12-14) in reading (M= 13.8, SD = 1.8, SE = 0.31, range = 9), writing (M = 13.2, SD = 1.8, SE = 0.31, range = 9) and maths (M = 13.7, SD = 1.7, SE = 0.30, range = 9). In the UK, academic years are divided into three terms. Research suggests that between term 2 (when the research was conducted) of year 5 and term 2 in year 6, pupils should achieve level 3 (15-17). The current sample had achieved or exceeded these expectations in reading (M = 18.03), writing (M = 16.95) and maths (M= 18.08). See Table 2 for information about mean academic performance and Table 3 for individuals' NC levels in reading, writing and maths.

On average, pupils in this sample attended school 98.05% of the time, which is higher than the average attendance rate for primary school pupils in England (M = 97.0%) for the academic year 2012-13 (DfE, 2013c). The DfE classify a pupil a *persistent absentee* when their mean attendance falls below 85%. None of the pupils in this sample reach this level.

Performance on Go/No-go Task

Accuracy. Mean accuracy rates were 46.85% for target (no-go) and 83.70% non-target (go) trials. Two repeated measures ANOVAs of mean accuracy rates for go and no-go trials indicated no main effect by block ($F < 1$, $p > .10$).

Table 3:
Frequency Data of Pupils' Current Academic Performance

NC level	Reading	Writing	Maths
2 (12-14)	3	4	2
3 (15-17)	3	11	9
4 (18-20)	22	18	19
5 (21-23)	6	1	4

Note: $n = 34$. Pupils achieving NC level 2 are below national expectations. Pupils achieving above NC level 3 are exceeding national expectations. Numbers in parenthesis indicate levels as denoted elsewhere in the analysis.

Reaction time. Two indices of RT on non-target (go) trials were calculated: means of individual subjects' mean RTs, reflecting central tendency; and means of individual subjects' RT standard deviations, reflecting intra-individual RT variability (i.e., fluctuations in attention). A repeated measures ANOVA indicated no main effect by block of either subjects' mean RTs or RT variability (in both cases $F < 1$, $p > .10$).

In previous studies, it was found that RTs were shorter in the few trials before participants made a target (no-go) commission error compared with those leading up to a correct (inhibition) response. This is thought to reveal habitual, mindless responding (Smallwood et al., 2004). In the present study, RTs for the four non-target trials preceding a target error averaged 394.23 ms and those preceding a correct response averaged 412.49 ms. While these results do support the trend found previously, these results were not significantly different in the current study $t(119) = 1.11$ ($p = .27$).

Thought reports. Subjects reported on-task thoughts on thought probes 48.2% of the time and off-task thoughts 21.9%. Task-performance thoughts were reported on 29.9% of thought probes (see Table 4). As is the case in previous studies, task-performance was considered neither an indication of on-task, nor off-task thoughts and furthermore was not found to correlate significantly with any key variables. TUT rate was not normally distributed, with the majority of participants reporting TUTs on fewer than 20 out of 60 thought probes (see Table 5).

Table 4:
Comparisons of Data for On-Task, Task-Performance and Off-Task Thoughts

Variable	On-Task	Task-Performance	Off-Task
Mean thought rate	48.2% (24.09,4.13)	29.9% (19.41,3.33)	21.9% (19.92,3.41)
Mean RT preceding thought report	422.49 ms (67.02,12.04)	416.14 ms (85.81,14.94)	396.82 ms (72.18,13.64)
Mean number of errors made on the preceding trial	3.26 (1.81, 0.31)	2.66 (2.36,0.40)	1.24 (1.33, 0.23)

Note: Numbers in parenthesis indicate (SD,SE), SD = standard deviation; SE = standard error of mean.

In previous research (McVay & Kane, 2009), TUTs have increased and on-task thoughts decreased over blocks. In this study, repeated measures ANOVAs indicated no significant main effect by block for either variable ($F < 1$, $p > .10$).

When participants made a commission error and reported off-task thoughts, their mean RTs for the four go trials preceding that report were faster (M = 396.82 ms), compared with the mean RTs for the four go trials preceding a commission error where on-task thoughts were reported (M = 442.49 ms; see Table 5). Although the trend in the data indicated that participants' RTs were faster preceding a report of off-task thoughts, this difference did not reach significance, $t(25) = -1.84$ ($p = .08$). When analysed using a repeated measures ANOVA, no significant main effect of block was found of RTs for trials before correct or incorrect no-go trials ($F < 1$, $p > .10$).

Performance by Thought Report. Analysis of the accuracy of trials immediately preceding a thought probe revealed that errors were made during on-task thoughts significantly more (M = 3.26) than during off-task thoughts (M = 1.24; see Table 5), $t(33) = -4.48$ ($p < 0.01$).

Individual Differences Between Variables

Correlations for study variables were analysed and are shown in Table 6. Self-report total anxiety, but not teacher-report anxiety, was significantly positively linked to self-report attention control, cognitive failures and task-unrelated thoughts (see Figure 1; all $p < .01$).

Table 5:
Frequency Data of Pupils' On-Task, Off-Task and Task-Performance Reports out of a Maximum of 60

No. times reported	On-task	Task-performance	Off-task
1-10	2	19	8
11-20	10	5	17
21-30	8	6	5
31-40	5	4	2
41-50	7	0	1
51-60	2	0	1

Note: $n = 34$.

Self-report attention control and cognitive failures were significantly positively related to each other ($p < .01$), but no other attentional indices were significantly correlated with each other. Self-report attention control and cognitive failures were negatively correlated with maths (both $p < .05$) and attendance ($p < .05$ and $p < .01$ respectively). As RT variability increased, listening recall, reading, writing and attendance significantly decreased (all $p < .05$; see Figure 2). While RT variability was negatively correlated with maths, this link was non-significant ($p = .08$). As self- report anxiety increased, maths decreased ($p < .05$; see Figure 1) and attendance decreased ($p < .05$). Teacher-report anxiety was significantly negatively related to backwards digit ($p < .05$) but no other variables, including self-report anxiety.

Children with high working memory scores in listening recall and backwards digit were significantly more likely to have higher achievement in writing (both $p < .05$), maths (both $p < .01$) and on an academic composite score ($p < .01$ and $p < .05$ respectively). Although both working memory measures were positively correlated with reading, only the link between listening processing and reading reached significance ($p < .05$). Only achievement in writing was significantly positively related to attendance ($p < .05$).

Table 6: *Correlations for Anxiety, Attentional, Verbal Working Memory and School Performance Variables*

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Anxiety														
1 Self-report	-													
2 Teacher-report	.09	-												
Attentional indices														
3 Self-report attention control	.79**	.05	-											
4 Cognitive failures	.57**	.07	.75**	-										
5 TUT rate	.51**	-.05	.26	.17	-									
6 RT variability	.01	.17	.17	.05	.03	-								
Verbal working memory														
7 Listening recall	-.12	-.07	-.08	.05	-.15	-.35*	-							
8 Backwards digit	.02	-.38*	-.11	-.22	-.11	-.15	.40*	-						
9 WM composite	-.06	.09	-.12	-.11	-.20	-.29	.82**	.85**	-					
School performance														
10 Reading	-.29	-.18	-.30	-.26	-02	-.37*	.40*	.28	.48**	-				
11 Writing	-.14	-.19	-.32	-.23	.14	-.40*	.38*	.36*	.45**	.82**	-			
12 Maths	-.36*	-.29	-.37*	-.35*	-.03	-.31	.47**	.44**	.54**	.77**	.72**	-		
13 AP composite	-.23	-.26	-.34	-.28	-.01	-.39*	.46**	.40*	.52**	.92**	.94**	.89**	-	
14 Attendance	-.35*	-.11	-.49*	-.44**	-.04	-.40*	.04	.09	.11	.33	.38*	.23	.32	-

Note. $n = 34$. $^{*}p < .05$ (2-tailed), $^{**}p < .01$ (2-tailed). Pearson's correlations were used for normally distributed variables, Spearman's rho was used for non-normally distributed variables. Depression was not significantly correlated to key variables and therefore not included. As self-report worry and total self-report anxiety were correlated so highly (.928, $p < .01$), only total self-report anxiety was included. TUT rate = proportion of self-reported task unrelated thoughts; RT variation = means of individual subjects' RT standard deviations. WM (Working Memory) Composite = Mean of Listening Recall and Backwards Digit scores. AP (Academic Performance) Composite = Mean of current NC levels in reading, writing and maths.

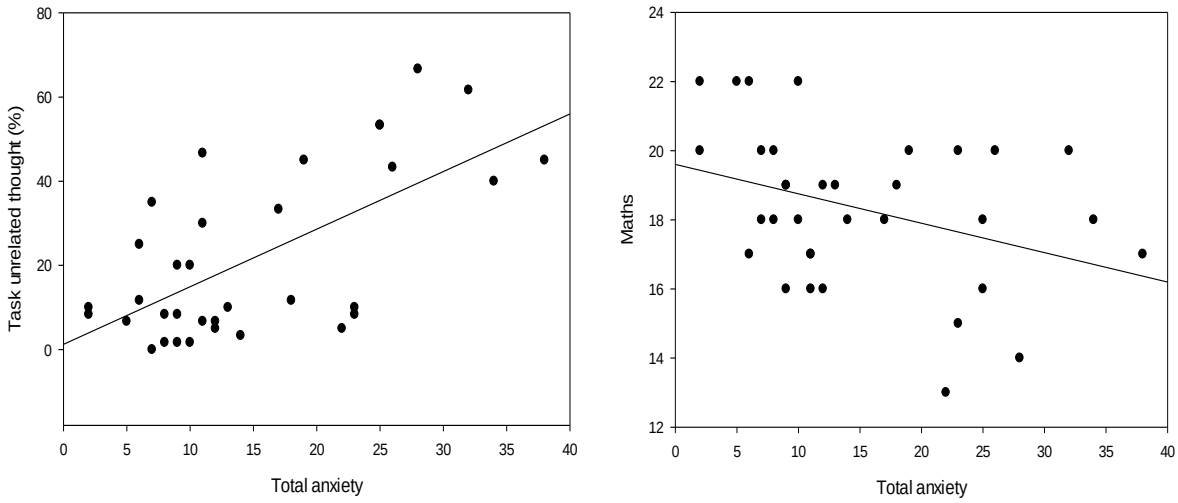


Figure 1: *Graphs to Show the Relationship Between Self-Report Anxiety and Mind Wandering (TUT Rate) and Maths Performance*

Results showed that RT variability and verbal working memory (composite score) were both significantly correlated with academic performance (composite score). A multiple regression analysis therefore examined the independent contribution of these two variables to the variance in academic composite scores, where academic composite scores were the dependent variable and working memory and RT variability were the independent variables. Because there were no assumptions about the importance of either variable, the forced entry method was used. Working memory was entered into step one producing a significant regression equation ($F(1,32) = 11.55$, $p < .01$),

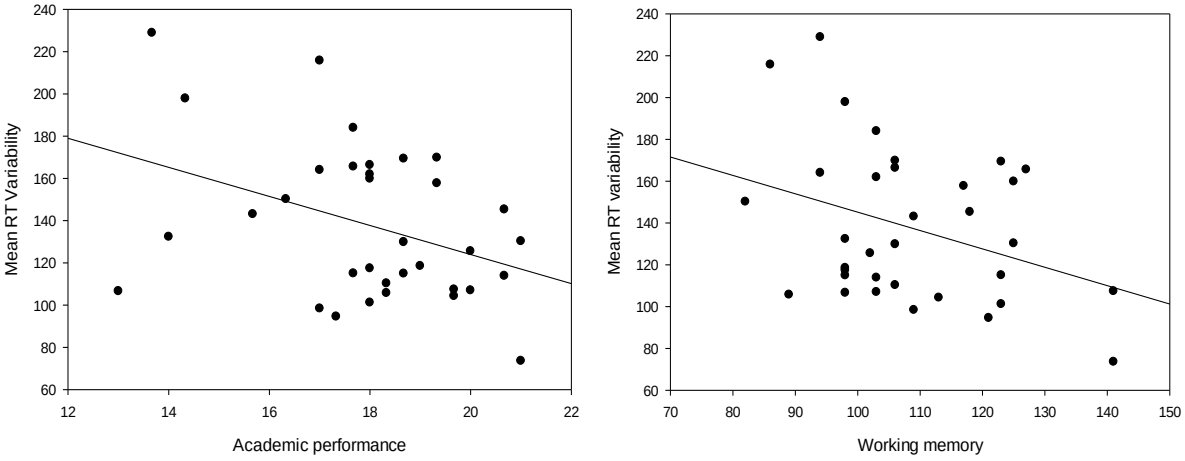


Figure 2: *Graphs to Show the Relationship Between RT Variability and Academic Performance (Composite Scores) and Verbal Working Memory (Listening Recall) and Maths Performance*

Table 7:
Regression Analyses Examining the Independent Contribution of Verbal Working Memory (composite score) and Attentional Fluctuations (RT Variability) to Composite Academic Performance Scores

	B	SE*B*	β
Step 1			
Constant	8.95	2.67	
Working memory	.08	.03	.52**
Step 2			
Constant	12.27	3.27	
Working memory	.07	.02	.44**
RT Variability	-.02	.01	-.26#

Note: Step 1: $R^2 = 0.27$, Step 2: $R^2 = 0.33$, $\Delta R^2 = 0.06$, $^{**}p < .01$, $^{\#}p = .10$

highlighting that working memory accounted for 27% of the variance in academic achievement. Entering RT variability on the second step also produced a significant regression equation ($F(2,31)=7.51$, $p < .01$), accounting for 33% of the variance in achievement; however the change in variance explained in this step was not significant (see Table 7) indicating that RT variability did not predict a significant amount of additional variance in achievement.

Exploring the Mediation Effect of Cognition in the Anxiety – Achievement Pathway

The current data showed that increased self-report anxiety was linked to achievement in maths. In addition, anxiety was associated with lower self-report attention control and increased cognitive failures and both of these cognitive factors were also negatively associated with maths. Therefore, two regression analyses were conducted to explore whether these indices of attention (self-report attention control and cognitive failures) mediated the relationship between anxiety and maths achievement. In both analyses a hierarchical regression was conducted, where anxiety was entered in Step 1 as a predictor variable and maths achievement was the dependent variable. In both analyses this produced a significant regression equation ($F(1,32) = 5.10$, $p < .05$), where anxiety explained 14% of the variance in maths achievement.

Table 8:
Regression Analyses Examining the Mediation Effect of Attentional Control and Cognitive Failures on the Relationship Between Anxiety and Maths Achievement

	B	SE*B*	β
Step 1			
Constant	22.02	1.67	
Anxiety	-.07	.03	-.37*
Step 2 (Attentional control analysis)			
Constant	21.69	1.74	
Anxiety	-.04	.05	-.21
Attentional control	-.05	.06	-.20
Step 2 (Cognitive failures analysis)			
Constant	21.84	1.68	
Anxiety	-.05	.04	-.26
Cognitive failures	-.03	.03	-.20

Note: Step 1: $R^2 = 0.14$, Step 2 (attentional control): $R^2 = 0.15$, $\Delta R^2 = 0.01$, Step 2 (cognitive failure): $R^2 = 0.16$, $\Delta R^2 = 0.02$ $^{*}p < .05$

Considering the meditating role of attentional control in Step 2, the regression equation was marginally significant ($F(2,31) = 2.78$, $p = .08$) accounting for 15% of variance in maths and anxiety was no longer significantly linked to maths (see Table 8). Though the reduction of anxiety in predicting maths indicated some mediating role of attentional control, the indirect effect to maths achievement via attentional control was not significant (i.e., was not significantly different from 0). Similarly, entering cognitive failures into Step 2 showed that the regression equation was marginally significant ($F(2,31) = 3.04$, $p = .06$), accounting for 16% of the variance in maths and anxiety no longer predicted maths. The indirect path was again not significant.

Discussion

The current study measured variables associated with attentional control using a go/no-go task with children to understand the relationship between these and other attentional indices (self-report attention control, self-report cognitive failures) with verbal working memory (listening recall, backwards digit), school performance (academic performance, attendance) and anxiety (self-report, teacher-report). The

study showed that self-report anxiety was related to self-report measures of attention, including mind wandering, and maths achievement in school. In addition, higher working memory was related to lower RT variability (individuals' attentional fluctuations) and better academic performance. In exploring the independent contribution of each variable on a composite measure of academic performance, the results showed that RT variability did not explain variance in academic achievement over and above that predicted by working memory scores. In addition, the two mediation analyses that considered the indirect paths between anxiety and attentional control or cognitive failures in mediating the negative association between anxiety and maths were not significant in this study.

In line with previous research on maths anxiety, working memory and maths performance (Ashcraft & Krause, 2007), this particular academic subject was found to be more highly correlated with self-report anxiety, working memory, self-report attentional control and cognitive failures than reading or writing. As a meta-analysis of prior research suggests, maths may be more affected by anxiety than other subjects, such as English or science (Ma, 1999), as maths is thought to place greater demand on working memory resources. These results lend support to this notion, despite a general anxiety rather than specific maths anxiety measure being used. It was expected that anxiety would be correlated with working memory, as has been found in previous studies (Kusché et al., 1993; Aronen et al., 2005; Owens et al., 2008; 2012a), however only teacher-report anxiety was found to be significantly related to verbal working memory, as measured by backwards digit span.

As expected, and in support of ACT (Eysenck et al., 2007), children with high working memory scores generally showed better reading, writing, maths and academic performance composite scores. These findings do not support those of Beilock and DeCaro (2007), who examined undergraduate students' performance on multistep maths problems under low- or high-pressure conditions. Their results suggested that individuals with higher working memory performed worse in these maths problems under high levels of pressure. However, the children in the current study may not have been assessed by their teachers undertaking the types of high pressure, highly demanding mathematical tasks that Beilock and DeCaro stipulate.

In the current study, accuracy for target (no-go) trials (84%) was higher than for non-target (go) trials (47%), in line with that of adults in previous research. The current

study found no effect of accuracy, mean RT, RT variability or TUT rate by block (i.e., task performance remained stable over time). In contrast, McVay and Kane (2009) found that although participants' mean RT remained stable over time, their RT variability increased over time. In addition, participants in McVay and Kane's study reported more TUTs and fewer on-task thoughts over time. Because the task in the current study allowed participants to take a break between blocks, this may have protected them from fatigue and allowed them to maintain attention throughout the task. In contrast, McVay and Kane report that their adult participants had a break for 30 seconds only after the fourth of eight blocks, which may explain why adults' performance deteriorated.

McVay and Kane found that adults' RTs for trials preceding target (no-go) errors were significantly shorter than those preceding correct responses. In other words, when adults hit the response keys mindlessly, they tended to respond faster. In the present study, children's responses preceding a commission error were shorter than those preceding a correct response, however this difference was small and non-significant (18.26 ms). Similarly, RTs for go trials preceding an off-task thought report were shorter, albeit non-significantly, than those preceding an on-task thought report in the current study. This was understood to mean that when children had attentional lapses and were not responding mindfully, as indicated by faster RTs, they also reported mind wandering.

Previous studies found that participants made higher numbers of target (no-go) errors before reporting off-task thoughts than before reporting on-task thoughts, (i.e., accuracy for no-go trials was lower when participants were mind wandering). In the current study, errors were made during on-task reports significantly more than off-task reports. This would suggest that mind wandering and commission errors do not always go hand in hand, in contrast to the argument put forward by some theorists (Smallwood, McSpadden, & Schooler, 2007). The current study may have differed in its findings to that of McVay and Kane because the current sample of children reported off task thoughts in small numbers (21.9% compared with 55% of adults) which, considering the smaller sample size, may explain why this study found an unexpected significant effect.

Results showed that TUT rate was skewed toward fewer off-task reports, with 16 out of 34 participants reporting off-task thoughts on 10% or less of thoughts probes.

Children may have experienced social desirability bias in the current study, not wanting to admit mind wandering, despite the experimenter being clear what the thought probes meant and that all thought types were normal and acceptable. Furthermore, children may have been more motivated to maintain attention on the task than adults due to social desirability. It is possible, on the other hand, that the children may not have been able to identify when they were having task-unrelated thoughts, although evidence suggests that children have normally developed this ability by age 8 (Flavell, Green, & Flavell, 1995).

In line with ACT (Eysenck et al., 2007), the current study showed that as self-report anxiety increased, attention control decreased and cognitive failures increased, supporting the notion that anxiety interferes with attention control mechanisms in children as well as adults. As has been found in previous studies, self-report and teacher-report anxiety were discrepant in the current study (see De Los Reyes & Kazdin, 2005). It was therefore important to consider the association between anxiety scores from different informants with other variables known to correlate with anxiety, in order to assess the validity of the constructs of anxiety measured. Self-report anxiety was found to be associated with other self-report measures of attention (attention control scale, cognitive failures questionnaire, TUT reports during the go/no-go task) rather than an experimental measure of attention (RT variability) or verbal working memory. In addition to attentional indices, self-report anxiety was found to negatively correlate with maths performance and attendance. Teacher-report anxiety was not linked to attentional or school performance indices.

Considering the results of the go/no-go experimental measure, TUT rate and RT variability were not found to correlate with each other or either of the questionnaire measures of attention (attention control scale and cognitive failures questionnaire). This is in contrast to McVay and Kane's study with adults, where TUT rate and RT variability were significantly correlated with cognitive failures and to each other. Furthermore, TUT rate and RT variability were significantly associated with working memory in McVay and Kane's study, but only RT variability was associated with working memory (listening recall) in the current study. RT variability was also negatively correlated, as expected, with all indices of school performance including academic achievement and attendance.

The finding that RT variability was significantly associated with verbal working memory (as measured by listening recall) and impaired academic performance is congruent with other research which has found that children with attention difficulties (e.g., ADHD) are more likely to have poor working memory and impaired academic performance than children without attention difficulties (Alloway, Gathercole, & Elliott, 2010). ACT (Eysenck et al., 2007) proposes that the central executive aspect of working memory is responsible for controlling attention and that failures in this system lead to impaired task performance, as has been found previously (Owens et al., 2012a). The finding that attention fluctuations and working memory were related to each other and to academic performance in the current study supports this notion.

Limitations and Future Research

This study extends current knowledge by showing that children's self-report trait anxiety was significantly related to attentional indices (including mind wandering) and performance in maths. Future research could extend current findings by measuring state and trait anxiety in order that the impact of state anxiety on other variables can be taken into account. Future research could further extend the current findings by measuring the relationship between subject-specific anxieties (e.g., maths anxiety) and attentional variables, to understand the differences or similarities between anxiety, working memory and attention variables for different subject areas.

The current study examined the relationships between anxiety, verbal working memory, attentional variables and academic performance. This is because verbal working memory has been shown to be a better indicator of academic performance in other studies (e.g., Owens et al., 2008). Future research could extend the current findings to investigate whether spatial or other aspects of working memory correlate with anxiety, attentional indices and academic performance in different subjects. Given the perceptual nature of stimuli in the go/no-go task, a measure of spatial working memory would offer greater insight into the processes involved with performance on this task.

There are still questions in the literature around the direction of causality in the anxiety – working memory relationship. The current study cannot address these as it uses a cross-sectional design. Longitudinal research is needed to determine whether anxiety impacts working memory processes, as suggested by Eysenck and Calvo (1992); or working memory processes lead to anxiety, as suggested by Ramirez, Gunderson, Levine

and Beilock (2013). A lack of longitudinal research also exists establishing the direction of the anxiety – attentional control relationship. While Eysenck et al. (2007) posit that anxious thoughts restrict the central executive's ability to direct attention and avoid distraction, it may be that attentional-control difficulties impair an individual's ability to learn effectively in an educational setting, which leads to anxiety. Future research should adopt a longitudinal design to analyse these relationships in more depth.

In the current sample, self-report total anxiety and worry scores were found to be of clinically elevated levels for 20.6% and 26.5% of pupils respectively. This indicates that although the sample mean seemed acceptable, some individuals in the sample were highly anxious and may therefore not represent a normal population. Care should therefore be taken when generalising the results from this study.

Implications for EP Practice

A better understanding of the cognitive and emotional mechanisms behind the disruption to academic performance experienced by anxious children will support our understanding of how executive functions are interconnected and allow us to test and develop current models that focus on understanding cognitive factors linked to school performance in anxious compared with non-anxious children.

The current study showed that an individual's vulnerability to experience fluctuations in attention (as measured by RT variability) was significantly associated with impaired academic performance, but was not associated with anxiety, indicating that other factors influence our ability to pay attention. Lindquist and McClean (2011) found that undergraduate students in the front third of a lecture theatre engaged in mind wandering less than those sitting further back. It may therefore be possible to create the right environment for children and young people to engage less in mind wandering. It has been suggested that mind wandering and mindfulness (i.e., learning to notice what is going on in our mind and bodies moment to moment) might represent opposing ends of the same construct (Mrazek, Smallwood & Schooler, 2012). Furthermore, a review has found that mindfulness has been shown to reduce anxiety in children and young people (Black, Milam, & Sussman, 2009). This implies that encouraging students to practice mindful meditation is just one way that teachers can reduce the negative impact of anxiety on mind wandering and academic performance.

Alternatively, it may be possible to support children to engage in more adaptive mind wandering. Smallwood and O'Connor (2011, p. 1488) suggest that teaching people more adaptive forms of mind wandering such as optimistic or empathic thoughts may "stabilise the cognitive/affective system of the individual and act as a buffer against the stresses of daily life". Teaching children the metacognitive ability to recognise mind wandering may also support children with attention difficulties, such as ADHD, to gain more from education (Thompson & Thompson, 1998). EPs could advise schools on strategies to teach children ways of reducing or engaging in more adaptive mind wandering.

Some children are more vulnerable to the negative effects of anxiety, such as children who have suffered neglect and abuse in early life. Children who are looked after by the local authority might also fall into this category. These children represent a group who would benefit from early intervention, and having a better understanding of how within-child cognitive skills impact on academic performance could help to identify which children would benefit most from those interventions described above.

Given the finding that anxiety was linked to impaired maths performance, those working with children and young people need to consider the usefulness of measures of academic ability, which may ultimately affect the future employability of young people (Hopko et al., 2003). Moreover, findings that teacher-reported anxiety and intra-individual attentional fluctuations (RT variability) were related to impaired performance on verbal working measures calls into question the reliability of the results of cognitive assessments for children and young people, which are administered regularly by EPs. EPs should consider using more dynamic approaches to cognitive assessment when possible, to avoid children gaining standardised scores which do not reflect their true abilities.

APPENDICES

Appendices

APPENDICES

Appendix A: List of search terms used in the systematic review

Searches were conducted in each database for each element of the theoretical framework. The search terms were first entered and then limiters were applied to retrieve studies which met inclusion criteria, for example 'peer reviewed journal' and 'English language'. Search terms were initially generated by the researcher with additional terms added based on keywords from relevant articles found during the search process.

1. PsycINFO (via EBSCO; 1887-2014): All search results from the search terms below were filtered by type of journal: 'peer reviewed' and language: 'English language'.

Topic=("Academic Underachievement") OR Topic=("College Academic Achievement") OR Topic=("Mathematics Achievement") OR Topic=("Reading Achievement") OR Topic=("Science Achievement") OR Topic=("Academic Achievement Prediction") OR Topic=("Academic Failure") OR Topic=("Academic Achievement") OR Topic=("Academic Aptitude") OR Topic=("Educational Objectives") OR Topic=("Educational Measurement") OR Topic=("Curriculum Based Assessment") OR Topic=("Intellectual Development")
AND
Topic=(Short term memory) OR Topic=(Memory) OR Topic=(Divided Attention) OR Topic=(Attention) OR Topic=(Concentration) OR Topic=(Distraction) OR Topic=(Task Switching) OR Topic=(sustained Attention) OR Topic=("executive function") OR Topic=("cognitive ability") OR Topic=(mind wandering)
AND
Topic=("Anxiety") OR Topic=("Mathematics Anxiety") OR Topic=("Performance Anxiety") OR Topic=("Test Anxiety") OR Topic=("Stress")

2. Web of Science (via Web of Knowledge; 1950-2014): All search results from the search terms below were filtered by type of publication: 'article', research domain: 'social sciences' and language: 'English'

Topic=("Academic Underachievement") OR Topic=("College Academic Achievement") OR Topic=("Mathematics Achievement") OR Topic=("Reading Achievement") OR Topic=("Science Achievement") OR Topic=("Academic Achievement Prediction") OR Topic=("Academic Failure") OR Topic=("Academic Achievement") OR Topic=("Academic Aptitude") OR Topic=("Educational Objectives") OR Topic=("Educational Measurement") OR Topic=("Curriculum Based Assessment") OR Topic=("Intellectual Development")

AND

Topic=(Short term memory) OR Topic=(Memory) OR Topic=(Divided Attention) OR Topic=(Attention) OR Topic=(Concentration) OR Topic=(Distraction) OR Topic=(Task Switching) OR Topic=(sustained Attention) OR Topic=("executive function") OR Topic=("cognitive ability") OR Topic=(mind wandering)

AND

Topic=("Anxiety") OR Topic=("Mathematics Anxiety") OR Topic=("Performance Anxiety") OR Topic=("Test Anxiety") OR Topic=("Stress")

3. BIOSIS Citation Index (via Web of Knowledge; 1956-2014): All search results from the search terms below were filtered by type of publication: 'article', research domain: 'social sciences' and language: 'English'

Topic=("Academic Underachievement") OR Topic=("College Academic Achievement") OR Topic=("Mathematics Achievement") OR Topic=("Reading Achievement") OR Topic=("Science Achievement") OR Topic=("Academic Achievement Prediction") OR Topic=("Academic Failure") OR Topic=("Academic Achievement") OR Topic=("Academic Aptitude") OR Topic=("Educational Objectives") OR Topic=("Educational Measurement") OR Topic=("Curriculum Based Assessment") OR Topic=("Intellectual Development")

AND

Topic=(Short term memory) OR Topic=(Memory) OR Topic=(Divided Attention) OR Topic=(Attention) OR Topic=(Concentration) OR Topic=(Distraction) OR Topic=(Task Switching) OR Topic=(sustained Attention) OR Topic=("executive function") OR Topic=("cognitive ability") OR Topic=(mind wandering)

AND

Topic=("Anxiety") OR Topic=("Mathematics Anxiety") OR Topic=("Performance Anxiety") OR Topic=("Test Anxiety") OR Topic=("Stress")

4. MEDLINE (via Web of Knowledge: 1950-2014): All search results from the search terms below were filtered by type of publication: 'article', research domain: 'social sciences' and language: 'English'

Topic=("Academic Underachievement") OR Topic=("College Academic Achievement") OR Topic=("Mathematics Achievement") OR Topic=("Reading Achievement") OR Topic=("Science Achievement") OR Topic=("Academic Achievement Prediction") OR Topic=("Academic Failure") OR Topic=("Academic Achievement") OR Topic=("Academic Aptitude") OR

Topic=("Educational Objectives") OR Topic=("Educational Measurement") OR Topic=("Curriculum Based Assessment") OR Topic=("Intellectual Development")

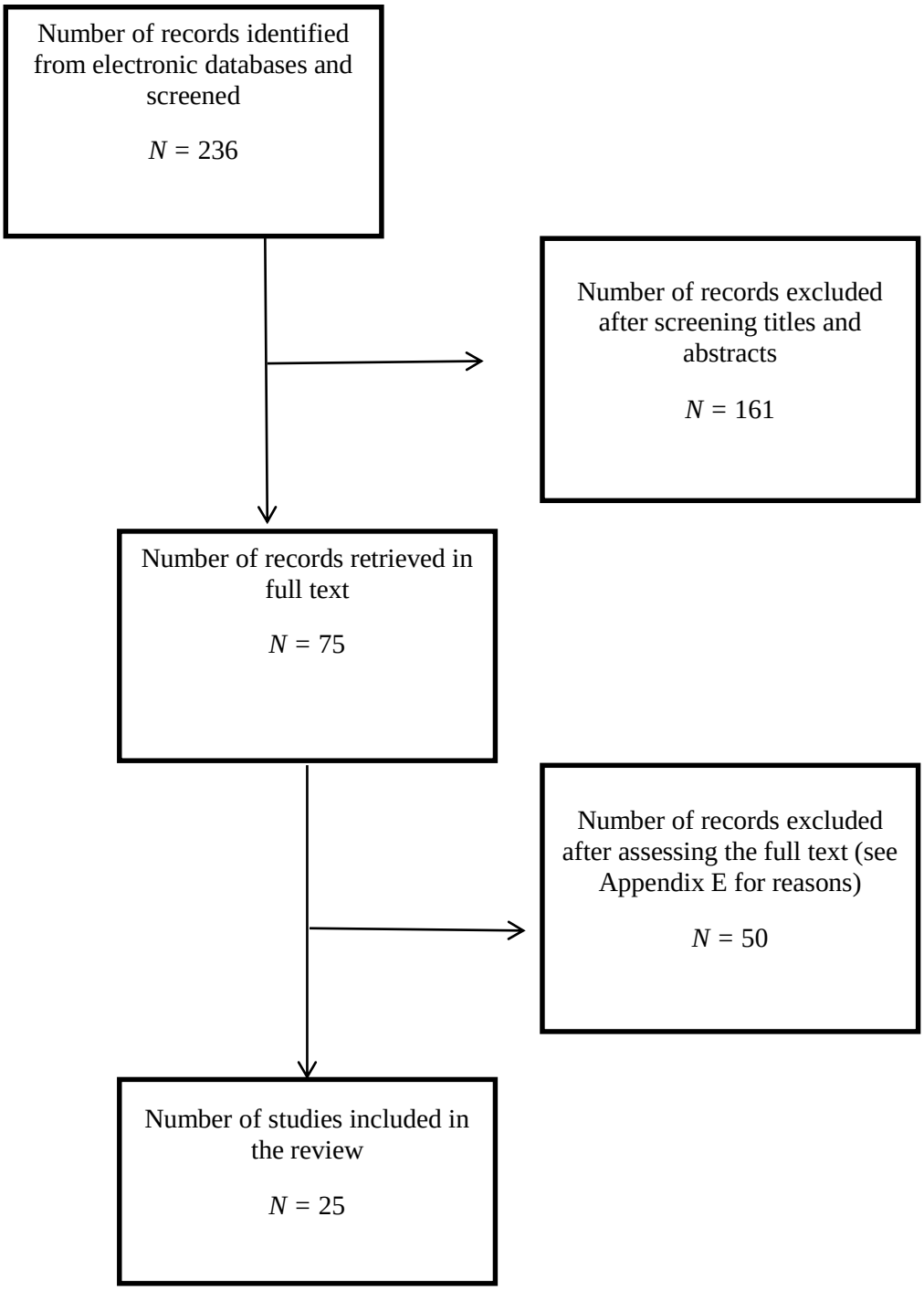
AND

Topic=(Short term memory) OR Topic=(Memory) OR Topic=(Divided Attention) OR Topic=(Attention) OR Topic=(Concentration) OR Topic=(Distraction) OR Topic=(Task Switching) OR Topic=(sustained Attention) OR Topic=("executive function") OR Topic=("cognitive ability") OR Topic=(mind wandering)

AND

Topic=("Anxiety") OR Topic=("Mathematics Anxiety") OR Topic=("Performance Anxiety") OR Topic=("Test Anxiety") OR Topic=("Stress")

Appendix B: Flow chart of inclusion and exclusion of records from the systematic review



Appendix C: Criteria for excluding papers after reading the full text

Following the screening of titles and abstracts, 75 papers were identified as relevant and retrieved in full text. After obtaining full text, a further 45 papers were excluded for the following reasons.

1. Papers presenting a review of research rather than original research (*n* = 10)
2. Could not access article (*n* = 1)
3. Studies that did not measure an attention or working memory (*n* = 11)
4. Studies that did not measure academic performance as an outcome (*n* = 6)
5. Studies that did not measure anxiety (*n* = 9)
6. Studies of efficiency of an intervention (*n* = 6)
7. Studies where participants were under the influence of chemicals/medication (had a diagnosis of Attention Deficit Hyperactivity Disorder or were adolescent smokers in nicotine withdrawal) (*n* = 3)
8. Duplication of records (*n* = 1)
9. Brief reports (*n* = 3)

Appendix D: School information form

RESEARCH IN PARTNERSHIP SCHEME INFORMATION FOR SCHOOLS	
Project Title	Understanding underachievement in school children who worry
Background	Research has generally found that children who worry do less well at school. Some studies suggest that increased worry leads to more distractibility and poorer working memory (i.e., the ability to remember and manipulate important key information in memory) which may, in turn, impact on children's school performance.
Aims of the project	The project will ask children and their teachers about children's worries or concerns. It will use computerised tasks to measure working memory and distractibility. It will consider whether performance on these tasks is important in understanding how well children do at school using teacher assessments and performance in standardised tests.
Who is conducting and supervising the project?	Samantha Beasley, a student on the Doctorate in Educational Psychology course, supervised by Dr Julie Hadwin and Dr Matt Garner.
What is the proposed start date and time frame?	We would like to start recruiting participants in October 2013 and we aim to collect most of the data before or just after December 2013.
What is the age group and gender?	Typically developing girls and boys in years 4 and 5 (aged 8-10) will be asked to take part.
What will we ask the school to do?	We will ask the school to distribute parent consent letters to parents with children in Years 5 and 6. We would like to work with around 40 children who will complete questionnaires in small groups and computer tasks individually with the researcher in a quiet area of the school. Teachers will be asked to complete a short school worry questionnaire on each of the children who take part. A copy of questionnaires we would like to use will be made available in the school office should parents want to look at them. Furthermore, the school will be asked to provide achievement data on each of the 40 children.
What will we ask the child to do?	The child will be asked to complete four questionnaires that measure (1) general worries (2) sad or negative thoughts, (3) how well they can control their attention and (4) how often they make silly mistakes as a result of not paying attention. This process will be carried out in groups of around 5 children and will take around 15 minutes to complete. Children will also be asked to individually complete two computer tasks to measure (1) working memory and (2) distractibility. These tasks will take around 10 and 20 minutes respectively.
What are the benefits for the school and/or the young person?	In this study, children will each receive a small gift and a certificate for taking part. Once the study is finished, we can provide a small poster for display in the school to outline briefly what we did and what we found.
How will the project help us to understand child development?	The project will help us to understand factors that can contribute to school underachievement. The work can help researchers and professionals working with children to develop measures to help young people who might experience elevated symptoms of worry and anxiety to achieve in school.

Appendix E: School Anxiety Scale (Lyneham, Street, Abbott, & Rapee, 2008)

School Anxiety Scale – Teacher Report

For each item please fill in the circle that best describes how this child has been **over the last three months or this school year**. Please answer all of the items.

	Never	Sometimes	Often	Always
1. This child is afraid of asking questions in class	○	○	○	○
2. This child speaks only when someone asks a question of them	○	○	○	○
3. This child worries what other people think of him/her	○	○	○	○
4. This child does not volunteer answers or comments during class	○	○	○	○
5. This child is afraid of making mistakes	○	○	○	○
6. This child hates being the centre of attention	○	○	○	○
7. This child hesitates in starting tasks or asks whether they understood the task before starting	○	○	○	○
8. This child worries about things	○	○	○	○
9. This child worries that (s)he will do badly at school	○	○	○	○
10. This child worries that something bad will happen to him/her	○	○	○	○
11. This child seems very shy	○	○	○	○
12. This child complains of headaches, stomach aches or feeling sick	○	○	○	○
13. This child feels afraid when (s)he has to talk in front of the class	○	○	○	○
14. This child hesitates to speak when in group situations	○	○	○	○
15. When this child has a problem, (s)he feels shaky	○	○	○	○
16. This child appears nervous when approached by other children or adults	○	○	○	○

Appendix F: Revised Child Anxiety and Depression Scale (Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000)

THINKING AND FEELING Please put a circle around the word that shows how often each of these things happen to you. There is no right or wrong answer.				
1. I feel sad or empty.	Never	Sometimes	Often	Always
2. Nothing is much fun anymore.	Never	Sometimes	Often	Always
3. I have trouble sleeping.	Never	Sometimes	Often	Always
4. I have problems with my appetite.	Never	Sometimes	Often	Always
5. I am tired a lot.	Never	Sometimes	Often	Always
6. I cannot think clearly.	Never	Sometimes	Often	Always
7. I feel worthless.	Never	Sometimes	Often	Always
8. I feel like I don't want to move.	Never	Sometimes	Often	Always
9. I feel restless.	Never	Sometimes	Often	Always

Appendix G: Attention Control Scale for Children (Derryberry & Reed, 2002)

These questions are about how well you feel you concentrate on your work.
Please answer each item, indicating how often it is true for you on the scale beside each question.

1. It's very hard for me to concentrate on a difficult task when there are noises around.	□almost never	□some times	□often	□always
2. When I need to concentrate and solve a problem, I have trouble focusing my attention.	□almost never	□some times	□often	□always
3. When I am working hard on something, I still get distracted by events around me.	□almost never	□some times	□often	□always
4. My concentration is good even if there is music in the room around me.	□almost never	□some times	□often	□always
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.	□almost never	□some times	□often	□always
6. When I am reading or studying, I am easily distracted if there are people talking in the same room.	□almost never	□some times	□often	□always
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.	□almost never	□some times	□often	□always
8. I have a hard time concentrating when I am excited about something.	□almost never	□some times	□often	□always
9. When concentrating I ignore feelings of hunger or thirst.	□almost never	□some times	□often	□always
10. I can quickly switch from one task to another.	□almost never	□some times	□often	□always
11. It takes me a while to get really involved in a new task.	□almost never	□some times	□often	□always
12. It is difficult to coordinate my attention between the listening and writing required when taking notes during lessons.	□almost never	□some times	□often	□always
13. I can become interested in a new topic very quickly when I need to.	□almost never	□some times	□often	□always
14. It is easy for me to read or write while I am also talking on the phone.	□almost never	□some times	□often	□always

15. I have trouble carrying out two conversations at once.	□almost never	□some times	□often	□always
16. I have a hard time coming up with new ideas quickly.	□almost never	□some times	□often	□always
17. After being interrupted or distracted, I can easily switch my attention back to what I was doing before.	□almost never	□some times	□often	□always
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.	□almost never	□some times	□often	□always
19. It is easy for me to alternate between two different tasks.	□almost never	□some times	□often	□always
20. It is hard for me to break from one way of thinking about something and look at it from another point of view.	□almost never	□some times	□often	□always

Appendix H: Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald & Parkes, 1982)

The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to your in the past 6 months. Please circle the appropriate number.

		Very often	Quite often	Occasio n- ally	Very rarely	Never
1.	Do you read something and find you haven't been thinking about it and must read it again?	4	3	2	1	0
2.	Do you find you forget why you went from one part of the house to the other?	4	3	2	1	0
3.	Do you fail to notice signposts on the road?	4	3	2	1	0
4.	Do you find you confuse right and left when giving directions?	4	3	2	1	0
5.	Do you bump into people?	4	3	2	1	0
6.	Do you find you forget whether you've turned off a light or a fire or locked the door?	4	3	2	1	0
7.	Do you fail to listen to people's names when you are meeting them?	4	3	2	1	0
8.	Do you say something and realize afterwards that it might be taken as insulting?	4	3	2	1	0
9.	Do you fail to hear people speaking to you when you are doing something else?	4	3	2	1	0
10.	Do you lose your temper and regret it?	4	3	2	1	0
11.	Do you leave important letters unanswered for days?	4	3	2	1	0
12.	Do you find you forget which way to turn on a road you know well but rarely use?	4	3	2	1	0
13.	Do you fail to see what you want in a supermarket (although it's there)?	4	3	2	1	0
14.	Do you find yourself suddenly wondering whether you've used a word correctly?	4	3	2	1	0

		Very often	Quite often	Occasio n- ally	Very rarely	Never
15.	Do you have trouble making up your mind?	4	3	2	1	0
16.	Do you find you forget appointments?	4	3	2	1	0
17.	Do you forget where you put something like a newspaper or a book?	4	3	2	1	0
18.	Do you find you accidentally throw away the thing you want and keep what you meant to throw away – as in the example of throwing away the matchbox and putting the used match in your pocket?	4	3	2	1	0
19.	Do you daydream when you ought to be listening to something?	4	3	2	1	0
20.	Do you find you forget people's names?	4	3	2	1	0
21.	Do you start doing one thing at home and get distracted into doing something else (unintentionally)?	4	3	2	1	0
22.	Do you find you can't quite remember something although it's "on the tip of your tongue"?	4	3	2	1	0
23.	Do you find you forget what you came to the shops to buy?	4	3	2	1	0
24.	Do you drop things?	4	3	2	1	0
25.	Do you find you can't think of anything to say?	4	3	2	1	0

Appendix I: The 'Mistakes with Thinking' Questionnaire (adapted from 'Cognitive Failures Questionnaire' by Broadbent, Cooper, FitzGerald & Parkes, 1982)

These questions are about small mistakes which everyone makes from time to time. We want to know how often these things have happened to you in the past 6 months. Please circle the number which sounds most like you.

		Very often	Quite often	Occasio -nally	Very rarely	Never
1.	Do you read something and find you haven't been thinking about it and must read it again?	4	3	2	1	0
2.	Do you find you forget why you went from one room to another?	4	3	2	1	0
3.	Do you fail to notice signs around school?	4	3	2	1	0
5.	Do you bump into people?	4	3	2	1	0
6.	Do you fail to listen to people's names when you are meeting them?	4	3	2	1	0
7.	Do you say something and realise afterwards that it might seem insulting?	4	3	2	1	0
8.	Do you fail to hear people speaking to you when you are doing something else?	4	3	2	1	0
9.	Do you lose your temper and regret it?	4	3	2	1	0
10.	Do you fail to see something you want on a shelf even though it's there?	4	3	2	1	0
11.	Do you find yourself suddenly wondering whether you've used a word correctly?	4	3	2	1	0
12.	Do you have trouble making up your mind?	4	3	2	1	0
13.	Do you find you forget when someone has asked you to be somewhere at a certain time?	4	3	2	1	0
14.	Do you forget where you put something like a magazine or a book?	4	3	2	1	0
15.	Do you find you accidentally throw away the thing you want and keep what you meant to throw away – for example throwing away the stickers and	4	3	2	1	0

	putting the wrapper in your pocket?					
16.	Do you daydream when you ought to be listening to something?	4	3	2	1	0
17.	Do you find you forget people's names?	4	3	2	1	0
18.	Do you start doing one thing at home and get distracted into doing something else (accidently)?	4	3	2	1	0
19.	Do you find you can't quite remember something although it's "on the tip of your tongue"?	4	3	2	1	0
20.	Do you find you forget what you came to the teacher to ask?	4	3	2	1	0
21.	Do you drop things?	4	3	2	1	0
22.	Do you find you can't think of anything to say?	4	3	2	1	0

Appendix J: Parent information sheet and consent form

Dear Parent or Carer,

Invitation to take part in a project: Investigating mind wandering in children

I would like to invite your child to take part in a study. Before you decide, you need to understand why the research is being done and what it would involve for your child. Please take time to read the following information carefully. Ask me if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

This project has two aims: (1) to understand whether mind wandering is related to a child's reports of negative feelings and memory and (2) to consider whether mind wandering is linked to school achievement in children.

Your child will be asked about their general worries they might have and how they generally are able to focus in daily life using questionnaires. I will ask the school for your child's achievement data already routinely collected by school. In addition, I would like to measure your child's memory and ability to stay focused using computer tasks. During the focus activity, your child will be asked whether they are thinking about what they are doing or if they are thinking about something else.

I hope this project will help us to understand the extent to which worries and concerns are linked to children's reports of how they feel, their memory, the extent to which their mind wanders and if these factors are linked to achievement. I hope the information will help us to develop ways of helping children who report negative feelings and mind wandering in school.

Why has my child been invited?

Your child has been invited to join the study because they are between 9 and 10 years of age and because all members of their class have also been asked to participate.

What will happen to my child if they take part?

If you and your child are happy to take part in the study, then I will arrange a time to talk about the project with the children in your child's class. I will arrange a time to speak to your child individually and for him or her to fill out a series of questionnaires about any general or school-related worries they might have. They will also be asked to do computer activities to measure how much they focus on what they are doing and also their memory. I will ask your child's school for information about their academic performance in school. Your child will have the opportunity to ask questions at all stages of the procedure.

What do I have to do?

You will need to read through this information sheet and decide if you are happy for your child to take part. If you are happy, then please return the reply slip in the envelope provided to your child's school.

What are the possible disadvantages and risks of taking part?

There are no disadvantages or risks involved in taking part in this study. Your child might find some of the questionnaires or the computer tasks difficult. The researcher will be around to help them.

What are the possible benefits of taking part?

At the end of the study I hope to have a better understanding of the impact of worry and negative affect in young people. It is hoped that our results will help young people in the future who experience school related difficulties as a result of worry or concern.

What will happen to the results of the research study?

The results from the study will provide us with information that can help us to understand worry and negative emotions. I will send your school a summary of what I have found and I will outline how this information might be useful for you and your child. Sometimes, once we have finished a project we will publish this information so other researchers can find out about what we have been doing and what we found. Any publication will be made available to your child's school.

What if there is a problem?

It is very unlikely that any part of this study will cause you or your child harm. However, if any aspect of the way you have been approached or treated in the course of the study causes you concern, please contact Samantha Beasley (email sb32g11@soton.ac.uk or telephone my supervisor, Dr Julie Hadwin, on 023 8059 2590). If you remain unhappy and wish to complain formally, you can do this through the Chair of the Ethics Committee, Psychology, University of Southampton, SO17 1BJ, UK. Phone: +44 (0)23 8059 4663, email slb1n10@soton.ac.uk.

Will my child's taking part in this study be kept confidential?

Yes. I follow best ethical and legal practice. All information collected about your child during the course of the research will be kept strictly confidential. Personal information will not be released to or viewed by anyone other than researchers involved in this project. All of the data collected will be coded so that your child can only be identified by me, my supervisors and a researcher involved in the study and (in line with University policy) it will be stored securely for 10 years and then destroyed. Results of this study will not include your child's name or any other identifying characteristics.

What will happen if my child does not want to carry on with the study?

If your child does not want to participate they are free to leave the study at any time.

Who is organising and funding the research?

The study is organised and funded through the University of Southampton.

Who has reviewed the study?

The study has been reviewed and approved by the Psychology Ethics' Committee and the University of Southampton's Research Governance procedures.

Does my child have to take part?

No, it's up to you and your child to decide together. If you are interested in the study please complete and send back the consent slip below. Your child cannot take part without your written consent. They are free to withdraw at any time, without giving a reason.

Yours sincerely

Samantha Beasley
Trainee Educational Psychologist

PARENT CONSENT FORM

Investigating mind wandering in school

Researchers' names: Samantha Beasley

Ethics reference: SB14

If you are happy for your child to take part in the study then please initial the box(es) if you agree with the statement(s):

1. I confirm that I have read and understood the information sheet (Sep 16th, 2013, version 1) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered. ☐

2. I confirm that I understand I have the option to deny giving personal information asked for if I wish to do so. ☐

3. I understand my child's participation is voluntary and they can withdraw at any time without giving any reason, without my legal rights being affected. ☐

5. I agree for my child to take part in this research project and agree for the data to be used for the purpose of this study ☐

Name of child _____Child's date of birth _____

Your name .....Your signature.....

Your relationship to the child .....Date.....

Appendix K: Child information sheet and consent form

Investigating mind wandering in school

You are invited to take part in a project about worrying, how you feel and how much your mind wanders, plus how well you do in school. Before you decide if you want to take part, it is important that you know why the research is being done and what it will be like. Please read and think about this information carefully. You can talk about it with your family and friends.

Why are we doing this?

We want to understand more about young people who have worries that can make them feel sad in school and think less about school work.

Why have I been invited to take part?

We are inviting all young people 9- 10 years old in your class.

Do I have to take part?

No, it is up to you. Before you decide, you can ask the researcher answer any questions you have. Your parent or carer has seen an information sheet and said they are happy for you to take part, but it is still up to you. If your answer is yes, you can fill out the form at the end of this sheet, but you can still stop any time without having to tell us why. You will have a copy of this sheet to keep.

What will happen to me if I take part?

If you say yes, we will ask you to fill out some questionnaires about how you think and feel. We will ask your school about how well you are doing in school and ask your teacher how they think you feel. There will also be some computer activities which will tell us about how you think and remember.

Why should I take part?

We hope this project will help us to understand feelings, mind wandering, and achievement in school in children. This is so we can try to help young people who report uncomfortable feelings and mind wandering in school. You will get a certificate and a £5 high street voucher for helping us.

What happens when the study is finished?

When we have seen what everybody answered, you and your school will get a summary of what we have found and how this might be useful for you. Sometimes, after a project is finished, we publish this information so other researchers can see what we did and what we found. But we will never publish your name or any other information about you.

What if there's a problem or something goes wrong?

We don't think you will have any problems with this project, but if you are worried about anything and you decide you want to stop that's OK.

Who is organising and paying for the research?

The research is organised and funded through Psychology at the University of Southampton. The study has been checked by people at University to make sure it is OK. It has also been checked by people at University who make sure it is ethical and safe.

Where can I get more information?

You can ask me any questions you have now or you can contact me, Sam Beasley, at Psychology, University of Southampton sb32g11@soton.ac.uk or ask your teacher or parent/carer to contact me.

What if I find some of the questions you ask upsetting?

If you need advice or help or feel worried about the questionnaires or anything we ask you to do, you can speak to...

- Your parent or carer
- Or your school counsellor: name
- Your 'role of safeguarding person eg Deputy Head' in school: name

You can also get out of school support from a helpline, such as Childline. People on Childline will talk to you about your worries and keep every conversation confidential. You can speak to someone on Childline by calling 0800 1111. You can find out further information online at: http://www.childline.org.uk

Investigating mind wandering in school

If you are happy to help us with this study, then answer the questions below and sign your name.

Do you have any questions? Yes ☐ No ☐

If Yes, please ask the researcher now. If No please answer the questions below:

- Have you read about this project? Yes ☐ No ☐
- Has somebody else explained this project to you? Yes ☐ No ☐
- Do you understand what this project is about? Yes ☐ No ☐
- Have you asked all the questions you want? Yes ☐ No ☐
- Were your questions answered in a way you understand? Yes ☐ No ☐
- Do you understand it's OK to stop taking part at any time? Yes ☐ No ☐

- Are you happy to take part? Yes ☐ No ☐

<u>If you want to take part, you can write your name below</u>

Your name _____ Date _____

The person who explained this project to you needs to sign too:

Print Name _____

Sign _____ Date _____

THANK YOU FOR YOUR HELP!

Appendix L: Ethical Approval

Your Ethics Amendment (Ethics ID:8166) has been reviewed and approved

ERGO [ergo@soton.ac.uk]

Actions

To:
Beasley S.
Inbox

11 November 2013 15:38

Submission Number 8166:
This email is to confirm that the amendment request to your ethics form (An exploration of executive functioning in anxiety related underachievement in children (Amendment 1))has been approved by the Ethics Committee.

You can begin your research unless you are still awaiting specific Health and Safety approval (e.g. for a Genetic or Biological Materials Risk Assessment)

Comments
None
Click here to view your submission

ERGO : Ethics and Research Governance Online
http://www.ergo.soton.ac.uk

DO NOT REPLY TO THIS EMAIL

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